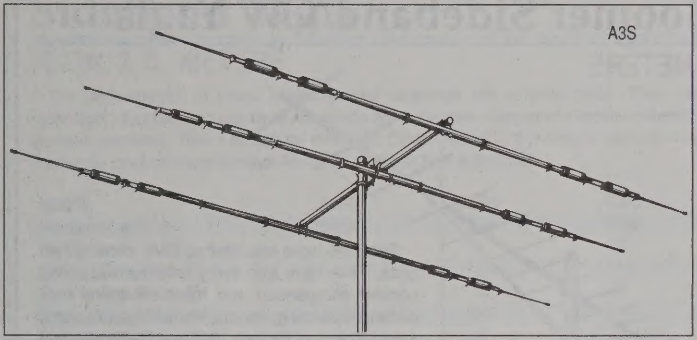


WORLD RANGER

MULTIBAND HF YAGIS 10, 12,15, 17, 20, 30, 40 METERS

A3S, A3WS, A4S BEAMS

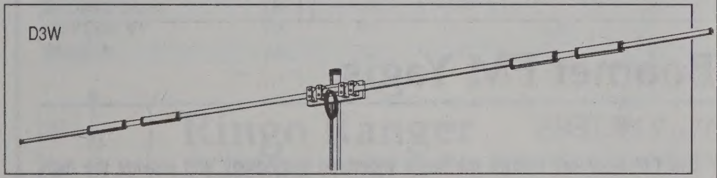
Our three and four element tribanders provide the versatility and performance that you need for reliable communication around the world. Cushcraft's World Rangers are made to last with 6063-T832 aluminum tubing, weatherproof traps, stainless steel hardware and fiberglass insulators. They are designed with fewer parts for easier assembly, lower weight and less windload.

A4S is the true, high performance tribander. Our best selling tribander, the A3S is a real power-house in a small space. 40 meters will come alive by adding one of our kits to the driven element of your A3S or A4S. The all new A3WS gives full performance on 12 and 17 meters and with the A103 add on kit will also cover 30 meters.

MODEL	A4S	A3S	A3WS
Frequency, MHz	28, 21, 14	28, 21, 14	24, 18
No. Elements	4	3	3
Forward Gain, dBd	8.9	8	8
Front to Back Ratio, dB	25	25	25
Power, Watts PEP	2000	2000	2000
Boom Length, ft	18	14	14
Longest Element, ft	32	27.8	25.1
Turning Radius, ft	18.4	15.5	14.4
Max. Mast Size, in	2	2	2
Wind Load, ft²	5.50	4.4	4.1
Weight, lb	37	27	22.5

WORLD RANGER 30 and 40 METER ADD-ON KITS

A 103 A 743, A 744	7MHz	10MHz	10MHz
Driven Element with Adapter Kit, ft	33.2 min 35.3 max	27.1 min 28.4 max	32.1
Windload, ft²	0.6	0.3	0.5
Bandwidth, KHz	125	150	250
Power, Watts PEP	2000	2000	2000
Weight, lb	3.5	2.3	3.3



ROTATABLE DIPOLES

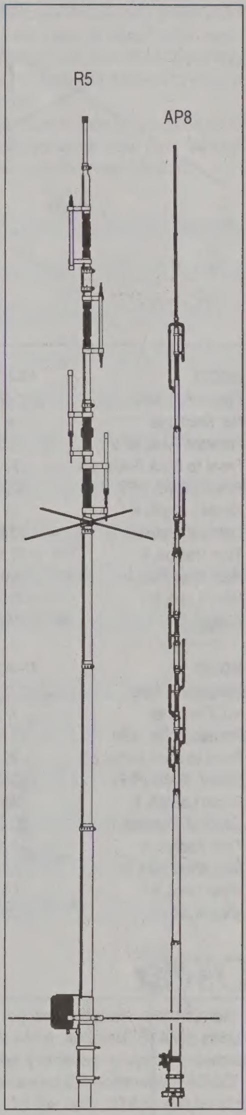
Cushcraft rotatable dipoles come single and multi-band. They feature high performance traps and heavy wall tubing. They can be mounted high and away from trees for better performance than a wire dipole. The new D3W is the perfect answer for the WARC bands.

MODEL	D40	D4	D3	D3W
Frequency, MHz	7	28, 21,14,7	28,21,14	24,18,10
Bandwidth, KHz	200	>350	>500	>200
Power, Watts PEP	2000	2000	2000	2000
Length, ft	42.3	35.8	25.8	34.0
Wind Load, ft²	1.3	1.3	0.9	0.9
Weight, lb	12	13	9	11

MULTIBAND HF VERTICALS

10, 12, 15, 17, 20, 30, 40, 80 METERS

R5 NO GROUND RADIAL VERTICAL



R5 is the latest five band development of our highly successful 1/2 wave length, no ground radial vertical antennas. R5 brings high performance and "mount it anywhere" features to hams living in apartments, condominiums or on small city lots. The heart of R5 is a broadband solid state impedance matching network which features fully automatic band selection and RFI suppression. You've heard R5 antennas on the air, now you too can experience the latest antenna performance with the all new R5.

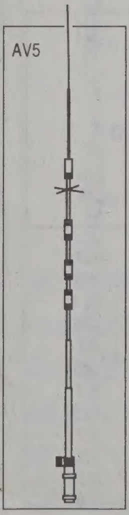
MODEL	R5
Frequency, MHz	28, 24, 21, 18, 14
Gain, dBi	3
Electrical Wavelength	Half Wave
SWR, 2:1 Bandwidth	Full Band
Power, Watts PEP	1800
Radiation Angle, Deg.	16
Height, ft	17
Max. Mast Size, In	1.75
Wind Load, ft²	1.4
Weight, lb	8.7

AP8 EIGHT BAND POWERWAVE

The Powerwave is an eight band vertical that features compact traps, broadband performance, and great versatility. Heavy-duty construction and stainless steel hardware will keep your Powerwave radiating for years.

Add our APR18 radial kit which includes pre-cut wire and connecting lugs.

MODEL	AP8
Frequency, MHz	28, 24,21,18,14,10,7,3.5
Electrical Wavelength	1/4
SWR, 2:1 Bandwith	Full Band Except 40M >150KHz 80M > 60KHz
Power, Watts PEP	2000
Radiation Angle, Deg.	18
Height, ft	<26
Max. Mast Size, In	1.75
Wind Load, ft²	1.5
Weight, lb	9.3
Radials Required	Normally
Radial Kit Available	Yes, APR 18



AV3 THREE BAND / AV5 FIVE BAND

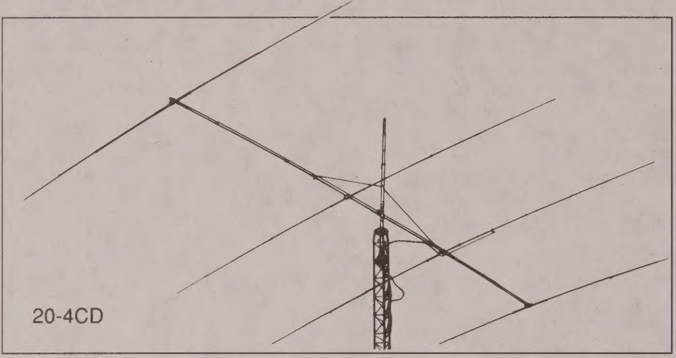
The AV5 works with the popular 10, 15, 20, 40 and 80 meter bands with broad bandwidth and full legal power. Our AV3 handles 10, 15 and 20 meter with fine performance and easy assembly. Add our APR18 radial kit which includes pre-cut wire and connecting lugs.

MODEL	AV3	AV5
Frequency, MHz	28, 21,14	28, 21, 14, 7, 3.5
Electrical Wavelength	1/4	1/4
SWR, 2:1 Bandwidth	Full Band	Full Band Except 80M > 70KHz
Power, Watts PEP	2000	2000
Radiation Angle, Deg.	18	18
Height, ft	14	25
Max. Mast Size, In	1.75	1.75
Wind Load, ft²	1.0	1.9
Weight, lb	5	8
Radials Required	Normally	Normally
Radial Kit Available	Yes, APR 18	Yes, APR 18

Skywalker Monoband HF Yagis

10, 12, 15, 20, 40 METERS

More contacts, less waiting, less interference, and a better signal at the other end are yours with a Skywalker! Construction features include stainless steel fasteners, pinned booms and heavy wall heat treated 6063-T832 aluminum tubing. All Skywalkers are full bandwidth (except for 40-2CD which is 200 KHz).



20-4CD

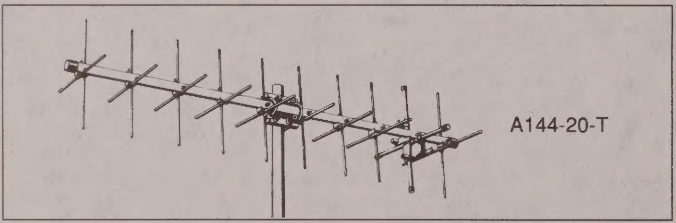
MODEL	10-4CD	10-3CD	TEN-3	12-4CD
Frequency, MHz	28.0-29.7	28.0-29.7	28.0-29.7	24.89-25
No. Elements	4	3	3	4
Forward Gain, dBd	10.0	8.0	8.0	10.0
Front to Back Ratio, dB	30	30	25	30
Power, Watts PEP	2000	2000	2000	2000
Boom Length, ft	16	10	8	18
Longest Element, ft	17.6	17.7	18.0	20.2
Turn Radius, ft	11.5	10.0	9.8	14.8
Max. Mast Size, in	2.0	2.0	2.0	2.0
Wind Load, ft^2	3.1	2.3	2.0	3.9
Weight, lb	18	11	9.9	21

MODEL	15-4CD	15-3CD	20-4CD	20-3CD	40-2CD
Frequency, MHz	21.0-21.45	21.0-21.45	14.0-14.35	14.0-14.35	7.0-7.3
No. Elements	4	3	4	3	2
Forward Gain, dBd	10.0	8.0	10.0	8.0	5.5
Front to Back Ratio, dB	30	30	30	30	20
Power, Watts PEP	2000	2000	2000	2000	2000
Boom Length, ft	20	14	32	20	23
Longest Element, ft	23.3	23.3	36.1	36.0	43
Turn Radius, ft	15.4	13.5	23.8	20	23.9
Max. Mast Size, in	2.0	2.0	2.0	2.0	2.0
Wind Load, ft^2	4.5	3.4	8.1	5.5	6.4
Weight, lb	25	20	55	30	44

Oscar

Here's the system that will get you up and running in a hurry. Cushcraft's AOP-1 includes our 416TB uplink, A144-20T downlink, A14-TMB mounting boom, and all of the hardware for quick assembly and installation.

OSCAR operation will be more fun with the optional remote polarity switch mounted right on the 416TB. You will access satellites having either left or right polarization.

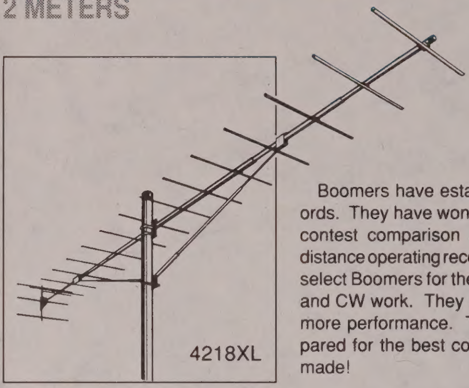


A144-20-T

MODEL	A144-10T	A144-20T	416TB
Frequency, MHz	145.9	145.9	435
No. Elements	2 x 5	2 x 10	2 x 8
Forward Gain, dBd	10.5	12.2	12.5
Front to Back Ratio, dB	20	20	20
Power, Watts PEP	800	800	500
Boom Length, ft	5.8	10.8	6.7
Longest Element, In	40	40	13.3
Turn Radius, ft	3.4	5.8	6.7
Mast Size, In	1.5	1.5	2.0
Wind Load, ft^2	0.7	1.4	0.5
Weight, lb	3.5	6.6	4.9

Boomer Sideband/CW Yagis

2 METERS

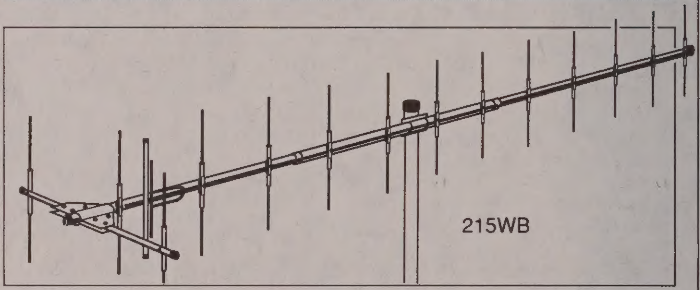


4218XL

Boomers have established EME contest records. They have won every antenna measuring contest comparison and have set many new distance operating records! Knowledgeable hams select Boomers for their VHF and UHF sideband and CW work. They are easy to stack for even more performance. Try a Boomer and be prepared for the best contacts that you have ever made!

Model	215WB	32-19	4218XL
Frequency, MHz	144-148	144-146	144-145
No. Elements	15	19	18
Forward Gain, dBd	15.2	16.2	17.2
Front to Back Ratio, dB	24	24	24
Power, Watts PEP	2000	2000	2000
Boom Length, ft	15	22	28.8
Longest Element, In	39.5	40	40
Turn Radius, ft	8.9	11	16.7
Max. Mast Size, In	2	2.0	2.0
Wind Load, ft^2	1.7	3.5	3.5
Weight, lb	8	12	14.3

MODEL	617-6B	424B	220B
Frequency, MHz	50-51	424-435	220-223
No. Elements	6	25	17
Forward Gain, dBd	14.0	18.2	17.2
Front to Back Ratio, dB	30	30	30
Power, Watts PEP	2000	2000	2000
Boom Length, ft	34	17.4	19
Longest Element, In	117	13	26
Turn Radius, ft	17.7	10	9
Max. Mast Size, In	2.0	2.0	2.0
Wind Load, ft^2	4.8	2.3	2.6
Weight, lb	26	4.5	10.5



215WB

Boomer FM Yagis

$1^1/_4$, 2 METERS

Our FM Boomers feature the latest wideband technology and provide the high performance that you want for FM work. If you are into packet, our Boomers will punch your signal through.

MODEL	124WB	215WB	230WB	224WB	225WB
Frequency, MHz	144-148	144-148	144-148	220-225	220-225
No. Elements	4	15	30	4	15
Forward Gain, dBd	10.2	15.2	18.5	10.2	15.5
Front to Back Ratio, dB	24	24	24	24	24
Power, Watts PEP	2000	2000	2000	2000	2000
Boom Length, ft	4	15	15	3	10
Longest Element, ft	40.75	39.5	39.5	26.7	26.3
Turn Radius, ft	4	8.9	9.5	3	5.8
Max. Mast Size, in	2	2	2	2	2
Wind Load, ft^2	0.3	1.7	4.0	0.2	1.0
Weight, lb	3	8	22	1.7	5.3

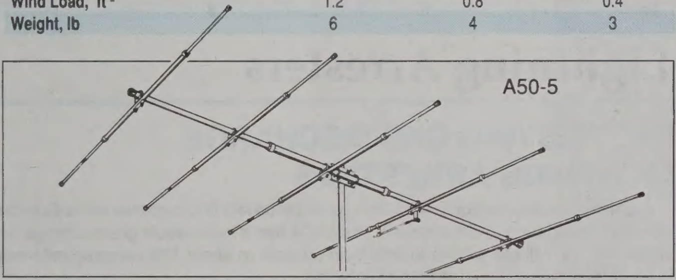
Sideband Yagis

70 CM, 2, 6, METERS

The performance of these budget-priced antennas will surprise you! They are lighweight, durable, and will have you on the air in a single afternoon! Good bandwidth, tapered elements, Reddi Match for direct 50 Ohm feed, and a moisture sealing vinyl connector boot are some major features of these fine antennas.

MODEL	A50-3	A50-5	A50-6
Frequency, MHz	50-54	50-54	50-54
No. Elements	3	5	6
Forward Gain, dBd	8	10.5	11.2
Front to Back Ratio, dB	20	22	24
Power, Watts PEP	1000	1000	1000
Boom Length, ft	6	12	20
Longest Element, ft	9.75	9.75	9.75
Turn Radius, ft	6	7.5	11
Max. Mast Size, In	2	2	2
Wind Load, ft ²	1.8	2.7	4.5
Weight, lb	7	11	18

MODEL	A144-11	A144-7	A430-11
Frequency, MHz	144-146	144-146	430-435
No. Elements	11	7	11
Forward Gain, dBd	13.2	11.1	13.2
Front to Back Ratio, dB	20	20	20
Power, Watts PEP	1000	1000	350
Boom Length, ft	12	8.2	4.7
Longest Element, In	40	40	14
Turn Radius, ft	6.8	4.9	2.6
Max. Mast Size, in	1.5	1.5	1.5
Wind Load, ft ²	1.2	0.8	0.4
Weight, lb	6	4	3

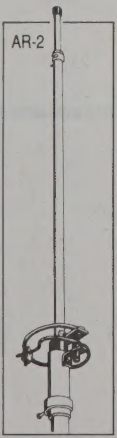

A50-5

Ringos (70 CM, 1¼, 2, 6, 10 METERS)

If you want a combination of compact size, wide bandwidth, a low radiation angle, these economical antennas are just for you. Since radials are not needed, you can even use our Ringos indoors. Ringos are 1/2 wavelength and include lightning protection.

MODEL	AR2	AR6	AR10	AR220	AR450
Frequency, MHz	135-160	50-54	28-29.7	220-225	440-460
SWR 2:1 Bandwidth, MHz	10	2	>1.5	10	20
Gain, dB	3.75	3.75	3.75	3.75	3.75
Power, Watts FM	1000	1000	1000	500	500
Radiation Angle, Deg	16	16	16	16	16
Height, ft	3.9	10.1	17.6	2.6	1.4
Max. Mast Size, in	1.25	1.25	1.25	1.25	.88
Wind Load, ft ²	0.2	0.4	1.7	0.2	0.1
Weight, lb	1.5	2.5	4	1.2	1.0

AR-2



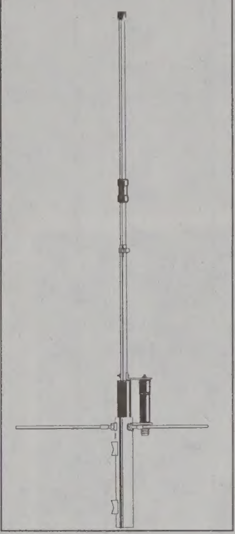
Ringo Ranger

2 METERS

This is the antenna that combines good gain with compact size. If space does not allow extra height or decoupling radials, the ARX-2 is for you.

Gain 4.5 dB, frequency range 135-160 MHz, SWR 2:1 bandwidth greater than 6 MHz, height 112", wind area .33 ft², max. mast size 1.25", weight 4 lbs, power handling 1000 Watts.

AR-270



Dual Band Ringo

70 CM, 2 METERS

Experience the performance and appearance advantages of an all aluminum dual band antenna. AR-270 incorporates Ringo Ranger technology in a lightweight and durable design with all stainless steel hardware.

With its two section vertical element and three short radials the antenna is very easy to install anywhere. The weather sealed phasing coil and base matching network eliminate stray RF currents while providing a very low angle of radiation.

A simple 50 Ohm cable connection is all you need to experience the full performance of your dual band 2 meter/70 cm transceiver with the new AR-270.

MODEL	AR270	
Frequency, MHz	144-148	435-450
SWR 2:1 Bandwidth	>4	>15
Gain, dB	3.7	5.5
Power, Watts FM	250	250
Height, ft	3.75	
Max. Mast Size, in	1.2-2.0	
Wind Load, ft ²	0.3	
Weight	2.0	

Ringo Ranger II

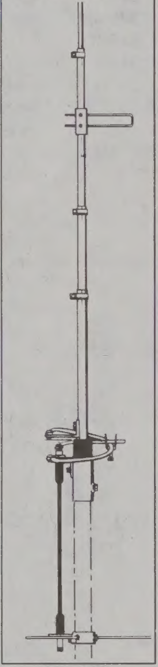
70 CM, 1¼, 2 METERS

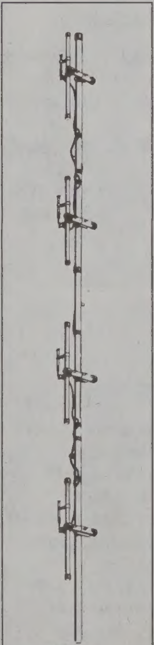
Our Ringo Ranger II has more gain, less windload, and more mechanical integrity than other two meter antennas. You will quickly appreciate the benefits of this amazing antenna! The Ringo Ranger II has built-in lightning protection, UV stabilized insulators, heavy wall tubing, improved decoupling radials to eliminate feedline radiation, and all-weather performance.

It's the performer. Over 500,000 have been sold!

MODEL	ARX2B	ARX220B	ARX450B
Frequency, MHz	135-160	220-225	435-450
SWR 2:1 Bandwidth, MHz	>3	>5	>10
Gain, dB	7.0	7.0	7.0
Power, Watts FM	1000	500	500
Radiation Angle, Deg	7	7	7
Height, ft	14.0	9.3	4.9
Max. Mast Size, in	1.25	1.25	.75
Wind Load, ft ²	0.5	0.3	0.2
Weight, lb	6	5	1

ARX-2B




AFM-4DA

Four Poles

(70 CM, 1¼, 2 METERS)

Cushcraft's four 1/2 wave dipole array is perfect for your repeater or as a powerful base antenna. Strong through-the-boom dipole mounting ensures long life and superior electrical characteristics. The dipoles mount to your tower's legs or on a separate support mast (not included). They can be arranged for omni or elliptical patterns.

MODEL	AFM-4DA	AFM-24DA	AFM-44DA
Frequency, MHz	144-148	220-225	435-450
SWR 2:1 Bandwidth	>4	>5	>15
Gain, dB	9 offset/6 omni	9 offset/6 omni	9 offset/6 omni
Power, Watts FM	500	500	250
Radiation Angle, Deg	6	6	6
Height, ft	23	15	8
Max. Mast Size, in	2.0	2.0	2.0
Wind Load, ft ²	2.5	1.9	1.1
Weight	7	6	5

Mobiles and Ducks

70 CM,1¼, 2, 6, 10 METERS

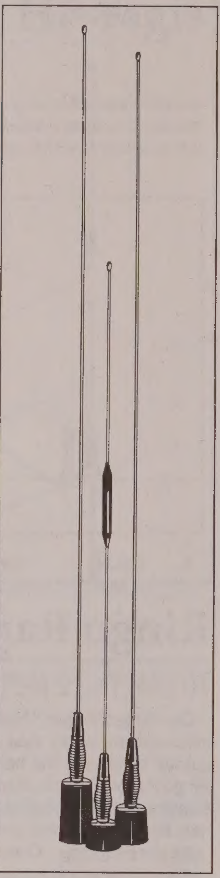
MOBILES

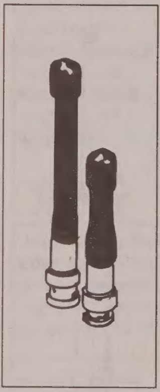
Our mobiles feature silver-plated coils, stainless steel springs, non-seize hardware, and shock proof coil cases. Plus RG58AU coax and silver-plated connectors for maximum signal transfer from your rig to the antenna. Our VHF models feature 3 dB gain and 5/8 wave electrical length. UHF mobiles provide 5 dB of gain.

Each type is offered with a choice of three mounts. Our popular magnet mounts have 90 pounds of holding power to keep your antenna secure. Our trunk-lip mounts are super easy to install on your trunk lid. And if you want permanent mounting, try our 3/4" hole-mount models.

3 dB Gain VHF
5 dB Gain UHF Mobiles

Model No.	Frequency MHz	Whip in	Description
CS-147M	144-174	49	Magnetic
CS-147T	144-174	49	Trunk Lip
CS-147	144-174	49	3/4" Hole
CS220M	220-225	33	Magnetic
CS220T	220-225	33	Trunk Lip
CS220	220-225	33	3/4" Hole
CS450M	435-470	29.5	Magnetic
CS450T	435-470	29.5	Trunk Lip
CS450	435-470	29.5	3/4" Hole
CS50M	46-54	49	Magnetic
CS50T	46-54	49	Trunk Lip
CS50	46-54	49	3/4" Hole
CS28M	28-30	49	Magnetic





RUGGED RUBBER DUCKS

Our new rubber ducks represent a quantum leap in product performance and long life. These new antennas are molded into a polyurethane sheath and last at least 10 times longer than standard portable antennas.

Cushcraft has the new long-lasting models with BNC connectors for many radios. Standard ducks with TK connectors are available for other popular radios. You can choose either a 6 inch or shorter mini duck.

Frequency MHz	Connector Type	6-inch Duck Model	Mini-Duck Model
144-148	BNC	BN141RD	BN141RS
144-148	TK	TK141	TK141S
220-225	BNC	BN220RB	BN220RC
220-225	TK	TK220B	TK220C
430-450	BNC	BN440RB	BN440RC
430-450	TK	TK440B	TK440C

STACKING FRAMES AND HARNESSES

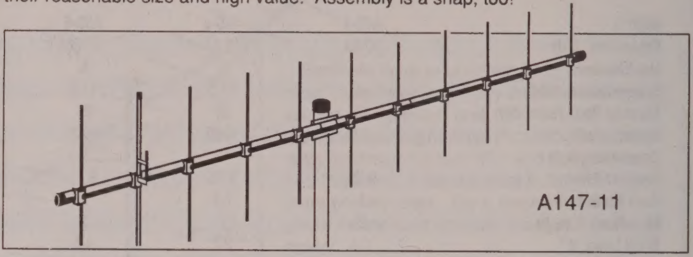
617-SK	for two 617-6B's
22-SK	for two 215WB's
32-SK	for two 32-19's
42-SK	Stacking Harness & PD, Two 4218XL
220-SK	Stacking Harness & PD, Two 220B
220-QK	Quad Stacking Kit, Four 220B
224-QK	Quad Stacking Kit, Four 215WB
230-VPK	Vert. Pol. Kit, Two 215WB
324-QK	Quad Stacking Kit, Four 3219
A14-SK	Stacking Harness for two A147-4
A14-VPK	Vert. Pol. Kit for two A147-4

A21-SK	Stacking Harness for two A220-11
A220-VPK	Vert. Pol. Kit for two A220-11
A147-SK	Stacking Harness for two A147-11
A147-VPK	Vert.Pol. Kit for two A147-11
A449-SK	Stacking Harness for two A449-6 or 11
A449-VPK	Vert. Pol. Kit for two A449-6 for 11
A11-SK	Stacking Harness for two A144-11
A17-SK	Stacking Harness for two A144-7
A41-SK	Stacking Harness for two A430-11
A535-SK	Stacking Harness for two A50-3/A50-5
A561-SK	Stacking Harness for two A50-6

FM Yagis

70 CM, 2 METERS

Two antennas have been keys to the growth of FM communication: our eleven element A147-11 and our 22 element A147-22 array. These are favorites because of their reasonable size and high value. Assembly is a snap, too!



MODEL	A147-11	A147-22	A449-6	A449-11
Frequency, MHz	145.5-148	145.5-148	440-450	440-450
No. Elements	11	22	6	11
Forward Gain, dBd	13.2	16.2	10.5	13.2
Front to Back Ratio, dB	20	20	18	20
Power, Watts PEP	800	800	350	350
Boom Length, ft	12	6.6 x 12	2.9	4.2
Longest Element, In	40	40	13	13
Turn Radius, ft	6	6.6	2.9	2.8
Max. Mast Size, In	1.5	1.5	2.0	1.75
Wind Load, ft^2	1.2	2.82	0.3	0.4
Weight, lb	6	15	3	4

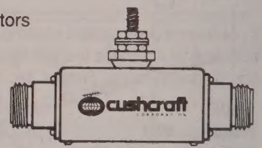
Lightning Arresters

FAST ACTING GAS DISCHARGE LIGHTNING ARRESTERS

Protect your valuable equipment from surges of up to 5,000 amperes with a Cushcraft constant impedance LAC4 arrester! The LAC4 has a replaceable gas discharge tube which clamps voltage surges to less than 50 volts in about 100 nanoseconds-much quicker than the voltage rise time of lightning.

You cannot afford to be without lightning protection. One of the models below is right for your shack.

LAC4	200 Watt with UHF SO-239 connectors
LAC4H	2 kw with UHF SO-239 connectors
LAC4N	200 Watt with N connectors
LAC4NH	2 kw with N connectors
LC2	200 Watt replacement cartridge
LC2KW	2 kw replacement cartridge



BLITZ BUG LIGHTNING ARRESTERS

Cushcraft also recommends this well-known series of arresters which are based on a patented three point static discharge design. The Blitz Bug has a sealed air chamber, constant static drain, and controlled voltage discharge.

The Blitz Bug is rated at 2 kw PEP to 500 MHz with negligible insertion loss.

LAC-1	with UHF PL-259 and SO-239 connectors
LAC-2	with UHF SO-239 connectors

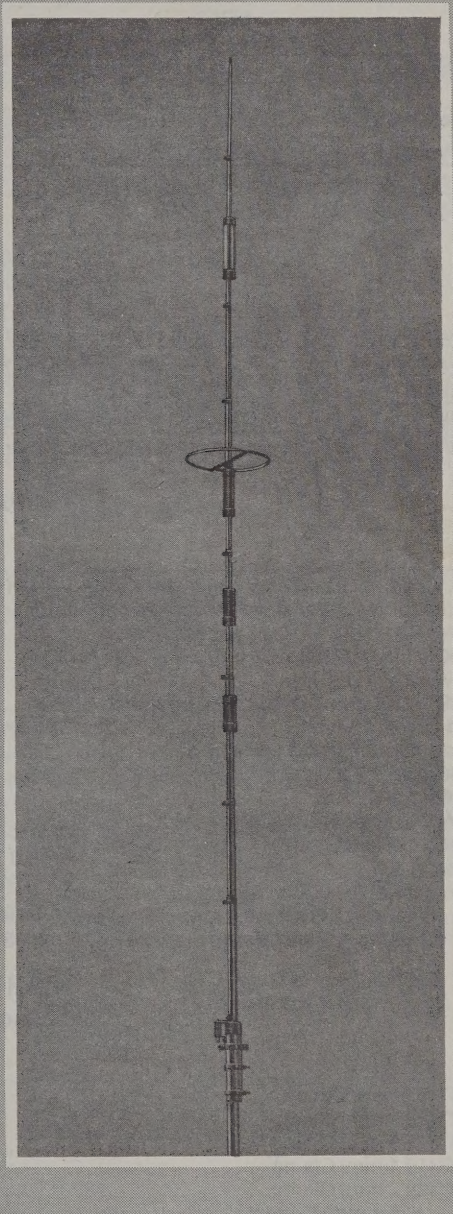
POWER DIVIDERS FOR BOOMERS

Our power dividers make it a snap to stack Cushcraft Boomers. They are available for these antennas:

PD-2	for two 32-19, 215WB or 4218XL's
PD-4	for four 32-19, 215WB or 4218XL's
PD-222	for two 220B, 224WB or 225WB's
PD-224	for four 220B, 224WB or 225WB's

cushcraft
CORPORATION

ASSEMBLY INSTRUCTIONS



ATV-3 ATV-4 ATV-5

ANTENNAS

The ATV-3, ATV-4and ATV-5 are a series of vertically-polarized, omnidirectional antennas designed to provide complete coverage of the 20-10 meter (ATV-3), 40-10 meter (ATV-4), and 80-10 meter (ATV-5) Amateur Radio bands. **WARNING:** This antenna is an electrical conductor. Contact with power lines can result in death, or serious injury. The antennas may be used with a transmitter that employs a nominal 50-ohm output, at up to the legal Amateur power limit. When properly assembled and mounted, each vertical will exhibit a relatively low angle of radiation, useful for long distance DX communications or local non-skip signals. Constructed of 6063-T832 aluminum tubing, each vertical combines a series of telescoping tubing sections with a set of "traps" to produce an efficient, broad-band antenna. The use of traps, or parallel-tuned resonant circuits, automatically changes the antenna's effective length, according to the frequency in use. The traps and antenna dimensions have been chosen so that the radior appears as an electrical 1/4-wavelength on each band. In addition, capacitive loading on the ATV-4 and ATV-5 provides expanded 40-meter coverage, in excess of that exhibited by a similarly short vertical. In conjunction with a highly conductive ground plane or wire radial system, each vertical will present a well-matched load to the coaxial feedline and radio equipment.

Prior to actually beginning the assembly of your Cushcraft vertical, you should spend a few minutes reading this manual, especially the sections describing the mounting configurations and radial/ground systems. With these factors in mind, assembly and installation can be accomplished with a minimum of wasted time and effort.

SPECIFICATIONS

	ATV-3	ATV-4	ATV-5
Overall Height - CW - Phone	14 ft, 1 in (4.28m) 13 ft, 7 in (4.14m)	20 ft (6.10m) 19 ft, 2 in (5.85m)	28 ft, 4 in (8.64m) 24 ft, 9 in (7.55m)
Wind Surface Area - CW	0.92 sq ft (.086 sq m)	1.26 sq ft (.117) sq m)	1.49 sq ft (.139 sq ft)
Assembled Weight	5.6 lbs (2.5 kg)	7.0 lbs (3.2 kg)	8.5 lbs (3.9 kg)
Maximum Mast Diameter	1-3/4 in (4.5 cm)	1-3/4 in (4.5 cm)	1-3/4 in (4.5 cm)
Frequency Coverage (MHz)	28.0 - 29.2 21.0 - 21.5 14.0 - 14.4	28.0 - 29.2 21.0 - 21.5 14.0 - 14.4 7.0 - 7.3	28.0 - 29.2 21.0 - 21.5 14.0 - 14.4 7.0 - 7.3 3.5 - 4.0
Nominal Input Impedance	50 ohms (Takes PL-259 connector)		
Standing - Wave Ratio	1.5: 1 or less at Resonance		
Power Handling Capability	2000 Watts P.E.P.		
Element Material	6063-T832 Hard-Drawn, Bright Finish Aluminum Tubing		
Trap Material	1/8 in (3.1 cm) Wall Fiberglass Tubing, with Enameled Copper Wire		

PARTS LIST

DESCRIPTION	QUANTITY ATV-3	 ATV-4	 ATV-5
Base assembly, 48 x 2 in OD (122 x 5 cm) overall, with 1-1/4 in OD (3.2 cm) aluminum tubing, insulator and coaxial connector	1	1	1
Aluminum tubing, 48 x 1-1/8 OD (122 x 2.9 cm)	1	1	1
10-meter trap, 48 x 1 in OD (122 x 2.5 cm), with 1-3/4 in OD (4.5 cm) trap cover	1	1	1
15-meter trap, 39-1/2 x 7/8 in OD (100 x 2.2 cm), with 1-5/8 in OD (4.1 cm) trap cover (4.1 cm)	1	1	1
Aluminum tubing, 18 x 3/4 in OD (46 x 1.9 cm)	1		
20-meter trap, 48 x 3/4 in OD (122 x 1.9 cm), with 1-1/2 in OD (3.8 cm) trap cover		1	1
Aluminum tubing, 48 x 5/8 in OD (122 x 1.6 cm)		1	1
40-meter trap, 48 x 1/2 in OD (122 x 1.3 cm) with 1-1/4 in OD (3.2 c,) trap cover			1
Aluminum tubing, 36 x 3/8 in (91 x .95 cm) OD			1
Aluminum Rod, 36 x 1/4 in OD (91 x 6.4 mm) diameter (91 x 6.4 mm)			1
Aluminum ring 1/2 section, 10 in (25 cm) diameter x 3/8 in (.95 cm)		2	2

PARTS PACKAGE

PART NO.	DESCRIPTION	ATV-3	ATV-4	ATV-5
S-5	3/8" (9.5 mm) Clamp			1
G-6	1/2" (12.7 mm) Clamp			1
G-7	5/8" (15.9 mm) Clamp			1
G-8	3/4" (19.1 mm) Clamp		1	1
G-9	7/8" (22.2 mm) Clamp	1	1	1
G-10-1/4	1" (25.4 mm) Clamp	1	2	2
G-11	1-1/8" (28.6 mm) Clamp	1	1	1
G-12	1-1/4" (31.8 mm) Clamp	1	1	1
10	#8 Stainless steel internal tooth lock washer		4	4
11	#8-32 Stainless steel hex nut		2	2
12	3/4" (19.1 mm) Plastic cap	1		
27	5/8" (15.9 mm) Plastic cap		1	
77	3/8" (9.5 mm) Plastic cap			1
79	#8-32 x 1/2" (12.7 mm) Stainless steel machine screw		2	2
83	1/4-20 x 1-1/4" (31.8 mm) Stainless steel machine screw	5	5	5
84	1/4" (64 mm) Stainless steel split lock washer	8	8	8
85	1/4-20 Stainless steel hex nut	8	8	8
90	Aluminum mast mount ring clap	2	2	2
104	1/4" (6.4 mm) I.D. Stainless steel flat washer	6	6	6
105	Formed aluminum guy wire/radial clamp	3	3	3
106	Formed aluminum ring bracket section		2	2

INSTALLATION INSTRUCTIONS

The ATV-3, ATV-4, and ATV-5 may be mounted in any of several configurations. It is important to mount the antennas as "in the clear" as possible, away from any metallic or conducting objects that might interfere with normal operation. The desired mounting configuration will determine which type radial/ground system will be the most efficient and practical.

WARNING: THIS ANTENNA IS AN ELECTRICAL CONDUCTOR, CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THIS ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION/REMOVAL, OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. WHEN THE ANTENNA IS IN USE, CONTACT WITH ANY PORTION OF THE VERTICAL RADIATOR OR GROUND SYSTEM MUST BE AVOIDED BECAUSE OF SHOCK DANGER FROM HIGH RF VOLTAGES. CONSULT THE NATIONAL ELECTRICAL CODE FOR FURTHER DETAILS.

MOUNTING CONFIGURATIONS

Ground Mounting: The antenna is mounted just above the surface of the ground, on a short self-supporting mast with a maximum outside diameter of 1-3/4 inches (4.5 cm). Ensure that the mast is driven into the ground enough to prevent any movement after installation of the vertical. The ATV-5 can be given additional strength, for windy environments, by attaching nylon or polyproplene rope just above the 20-meter trap (see Figure 4). **Do Not** use any metal wire for the guys. In this configuration, either tuned or untuned radials may be used, with the untuned system providing the greatest overall efficiency.

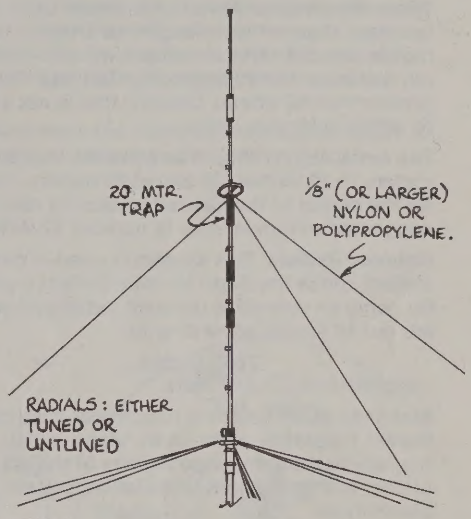

20 MTR. TRAP
1/8" (OR LARGER) NYLON OR POLYPROPYLENE.
RADIALS: EITHER TUNED OR UNTUNED

Figure 4
Example: ATV-5

Mast Mounting: In this arrangement, the antenna is mounted on a well-guyed mast, some distance above the ground (see Figure 5). This method is particularly advantageous for the 10, 15, and 20 meter bands, especially where the antenna is surrounded by trees or other obstacles. In addition, tuned radials should be used, eliminating the requirement for an extensive untuned radial system. Several of the radials can be used as guy wires, providing additional strength for the antenna and mast. The mast can be guyed independently of the antenna; guy wires do not have to be a specific length or broken with insulators as long as they are below the radials.

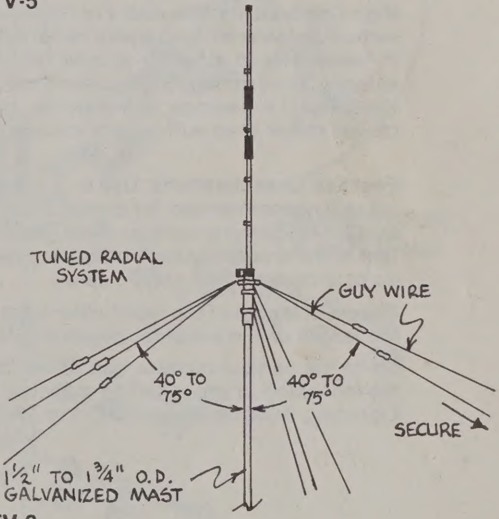


Figure 5
Example: ATV-3

Roof Mounting: This method is very similar to Mast Mounting (see Figure 6). In many cases, mounting the vertical "in the clear" on the roof will provide the most efficient antenna system. As with Mast Mounting, three of the tuned radials can serve as guy wires. (Ensure that the support structure is well grounded through the appropriate ground wires and rods for lightning protection). A special case occurs when the antenna is mounted over a relatively flat, metal roof. In this configuration, the metal acts as a ground plane, eliminating the need for any radials. The base of the antenna should be mounted as close to the metal roof as possible, with a short electrical connection between the roof and mast mount portion of the antenna.

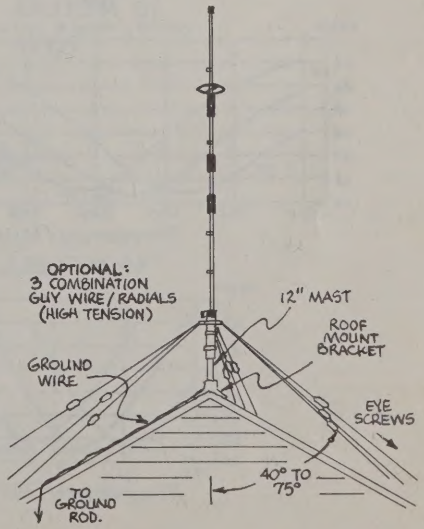


Figure 6
Example: ATV-4

RADIAL/GROUND SYSTEMS

CAUTION

When operating the antenna, ensure that no one can come in contact with the radial system, as a serious shock can result. In addition, make sure that the antenna and radials can not come in contact with electrical conductors, especially power lines, **at any time.**

Tuned Radials; In this system, the radials are used to simulate a conductive ground-plane for the vertical radiator. In general, you should use at least three radials per band. The tuned radial system is most effective when used with an antenna that is **not** mounted on the ground. To be effective, the radials must be insulated from the ground, except where they are attached to the antenna. For the ATV-4 and ATV-5, it is not absolutely essential to have separate radials for 15 meters since the 40-meter radials will serve as tuned radials for this band. The wires for the radial system are cut to the correct length, for the desired frequency, by using the Radial Length Chart shown on the following page or by the following formulas:

$$\text{Length} = \frac{2970 \text{ inches}}{F \text{ MHz}} \quad \text{or} \quad \frac{247.5 \text{ feet}}{F \text{ MHz}} \quad \text{or} \quad \frac{75.44 \text{ meters}}{F \text{ MHz}}$$

These dimensions do not include any extra length needed for connection to mounting hardware or insulators. The lengths are slightly longer than 1/4 wavelength, to closely match the antenna system to 50-ohm coaxial feedline. In addition, the angle made by the radials and the vertical radiator will affect the input impedance, and hence the SWR. In general, the closer the radials are to horizontal, the lower the impedance (often less than 50 ohms), and conversely, the closer to vertical, the higher the input impedance (often greater than 50 ohms). Usually, this is not an extremely critical consideration, but their position can be used to help adjust the SWR to within tolerable limits.

The radial length should be accurate to within plus or equal to 1-1/2% of the desired length; this ranges from 1-1/2 inches (4 cm) at 10 meters to 12 inches (30 cm) at 80 meters. Satisfactory operation across each band segment will generally result with the radials cut for the center of the desired frequency range. Wire size is not critical, as long as the radials are large enough to prevent breakage. A suggested minimum size is number 22 AWG (0.6 mm).

Untuned Radials: This system is used in conjunction with a ground-mounted vertical, where safe buried or surface radials can be installed. Since the Earth is not a perfect conductor, excessive power is lost in the ground, instead of being radiated by the antenna. By using an extensive untuned radial system, ground losses are reduced, with a subsequent increase in radiated-power. The radials are cut to length according to:

$$\text{Length} = \frac{2360 \text{ inches}}{F \text{ MHz}} \quad \text{or} \quad \frac{196.7 \text{ feet}}{F \text{ MHz}} \quad \text{or} \quad \frac{60 \text{ meters}}{F \text{ MHz}}$$

Since the exact length is not critical, they may be cut longer or shorter if desired; at least three radials should be long enough for the lowest frequency to be used. Many radials of shorter length may be used to make the ground resistance as low as possible, particularly in the immediate vicinity of the antenna. Here again, wire size is not critical as long as the radials are not subjected to undue stress. In a permanent installation, copper, aluminum, or galvanized steel wire is the most suitable for preventing corrosion due to electrolysis.

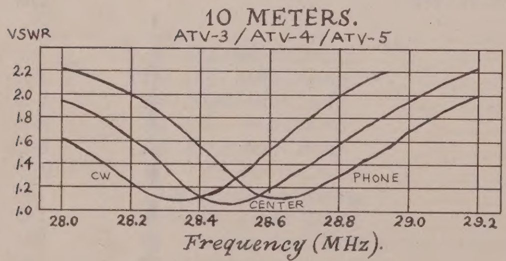
High Conductivity Grounds: For those fortunate enough to live in an area of excellent ground conductivity, it is possible to operate a vertical antenna without a wire radial system. The antenna should be ground mounted, and electrically connected with a short length of heavy wire to a nearby ground rod. As with the untuned radials, good conductivity, especially in the immediate vicinity of the antenna, is essential. Ground conductivity is not easily measured. High ground conductivity is most apt to occur in a low, wet environment, i.e. swamps, salt marches, or near large bodies of water. When uncertain of your ground conductivity, it is best to install radials rather than suffer from excessive ground losses.

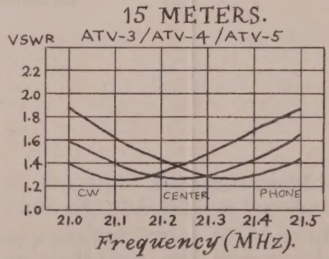
Feedline Considerations: Use of a good quality 50 or 52-ohm cable between the antenna and your radio equipment. An RG-8 type cable is recommended for power levels above 300 watts, or for cable runs longer than about 30 feet (10 meters). You may use the smaller RG-58 type cable at lower power levels and for short feedline runs. In either case, the cable must have a PL-259 for connection to the antenna. After connecting the cable, the connector should be sealed with a silicone sealant and/or electrical tape followed by a coat of clear acrylic spray.

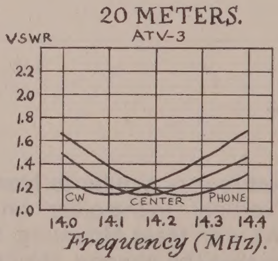
The exact length of the feed-cable is not critical. In some cases, it may be possible to reduce the SWR at the transmitter by adjusting the length of the feedline. However, it is best to ensure that the entire antenna system exhibits a 50-ohm base impedance.

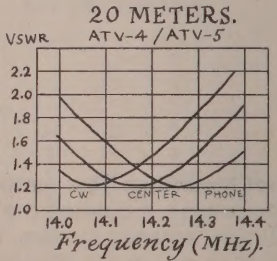
Since the vertical radiator and center conductor of the coaxial cable are not grounded, the feedline, when not in use, should be disconnected or grounded by a switch for lightning protection. For protection from static buildup, use the Cushcraft "Blitz Bug" Lightning Arrester, Model LAC-1 or LAC-2, in the feedline.

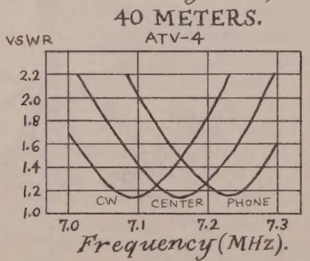
TYPICAL SWR GRAPHS

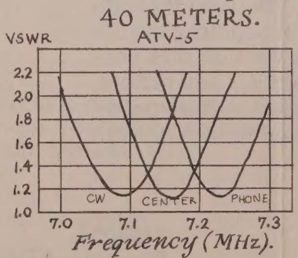


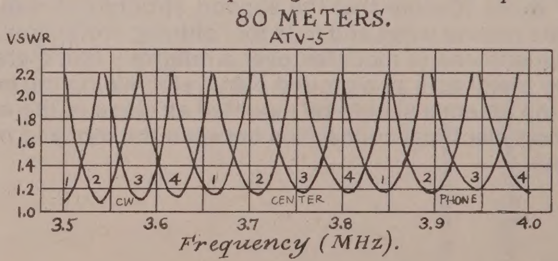












ASSEMBLY INSTRUCTIONS

Each Cushcraft vertical has been designed for easy assembly, in addition to efficient operation. Each part, and the quantity necessary, has been described in the preceeding parts list/package. The ATV-3, ATV-4, and ATV-5 are assembled in accordance with the Nominal Dimensions Chart and diagram on the facing page. Each vertical is constructed of a series of telescoping aluminum sections starting with 1 1/4" (31.8 mm) tubing for the base selection. The traps and tubing have been integrated, at the factory, into a single ready-to-use assembly, eliminating any unnecessary mechanical problems.

The various dimensions listed in the Nominal dimensions Chart will generally permit the antenna to cover a majority, if not all, of the most-used portions of each Amateur band. This will enable you to set the antenna for the designed frequency coverage. Prior to assembly of the tubing, each trap and associated cover is assembled as shown in Figure 1.

Ensure that each trap is positioned so that the drain hole and slots in the tubing are above the actual trap, and the drain hole in the trap cover is below the trap (see Figure 2). Following installation of the trap covers, the telescoping sections are assembled, with the compression clamps used to secure the sections. Referring to the parts list, note that each trap can be identified by the size of the aluminum tubing on which it is installed.

After completion of the vertical radiator, the aluminum mast mount rings and radial/guy wire clamps are assembled onto the base assembly as shown in figure 3. Secure the three guy wire/radial wire clamp sections to the base assembly, but for ease of installation, do not tighten the hardware that holds the radials. On the ATV-4 and ATV-5, the capacitance ring is assembled as shown in Figure 2. Placement of the ring is not critical, as long as it is not more than 4 inches (10 cm) above the 20-meter trap. Also, when installing the ring, ensure that the drain hole in the tubing is not obstructed.

As a final step, prior to installation, check all dimensions to ensure that they agree with those from the Nominal Dimensions Chart. If desired, dimensions may be set between chart values, for adjustment of the frequency ranges shown by the SWR curves.

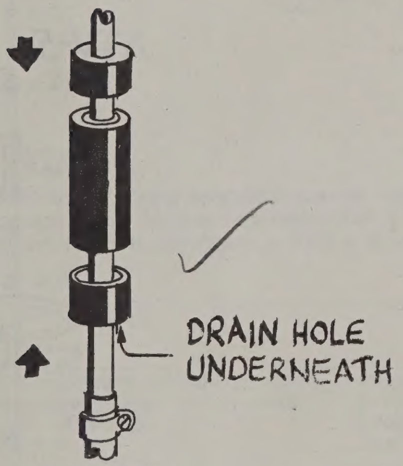


FIGURE 1.

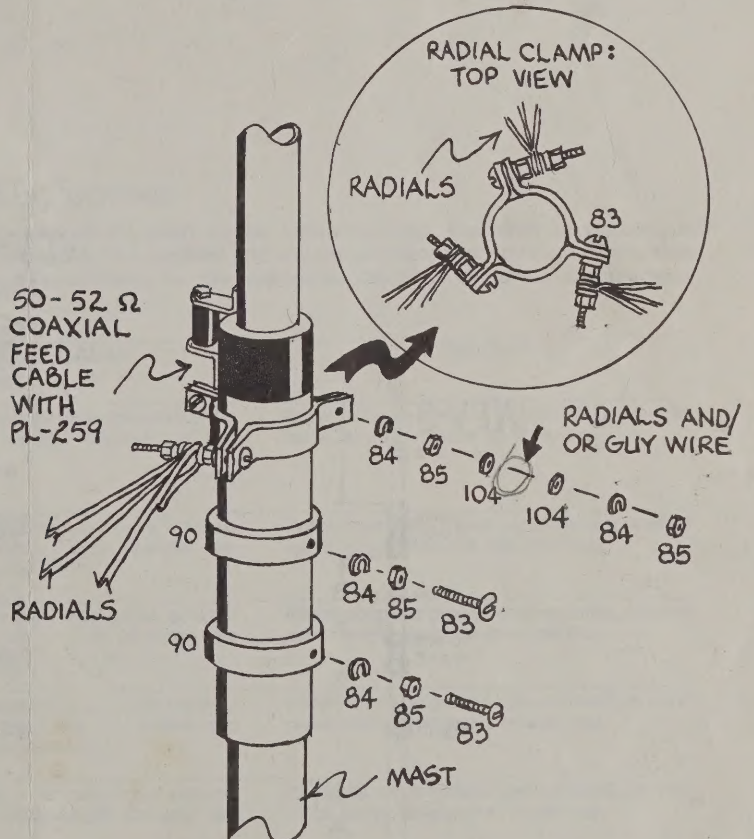


FIGURE 3

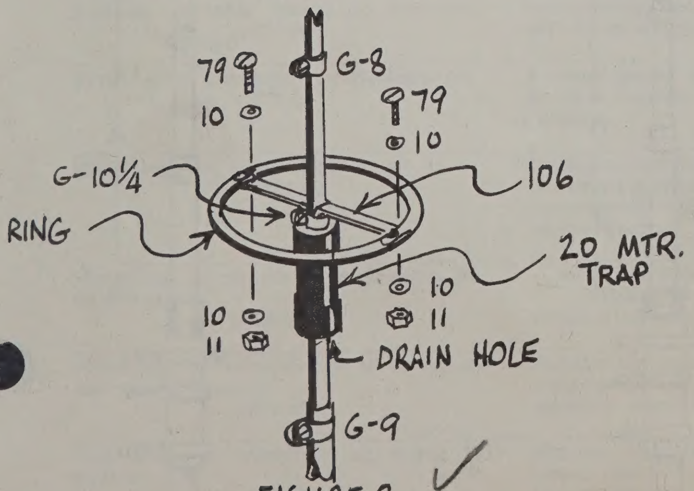


FIGURE 2.

NOMINAL DIMENSIONS CHART

ATV-3

SECTION	CW	CENTER	PHONE
A	101 in (257 cm)	98-1/4 in (250 cm)	95-1/2 in (243 cm)
B	17 in (43 cm)	17 in (43 cm)	17 in (43 cm)
C	30 in (76 cm)	30 in 76 cm)	30 in (76 cm)
OVERALL*	14 ft, 1 in (4.28 m)	13 ft, 10 in (4.21 m)	13 ft, 7 in (4.14 m)

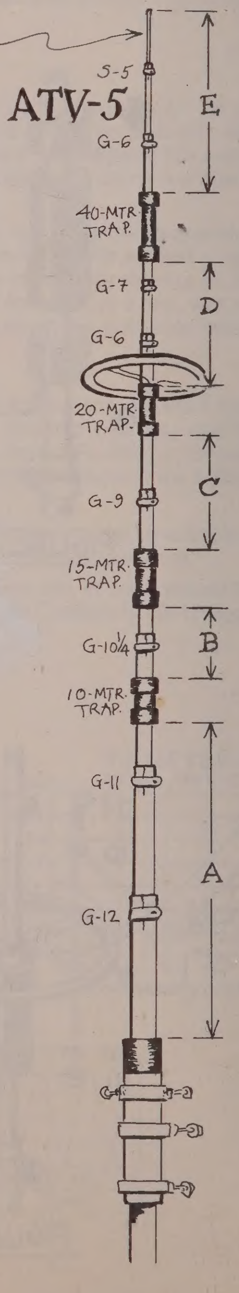
ATV-4

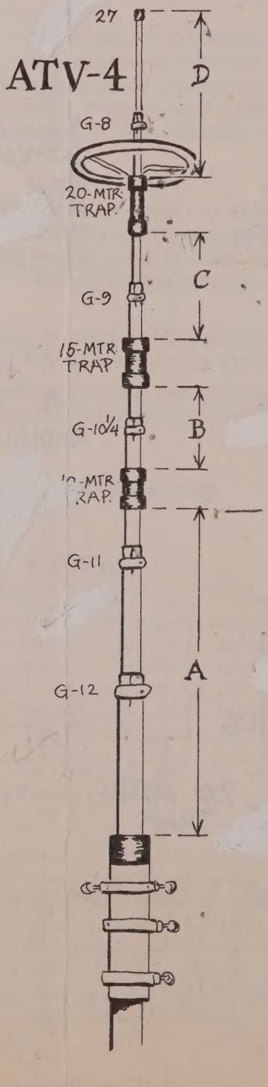
SECTION	CW	CENTER	PHONE
A	101 in (257 cm)	98-1/4 in (250 cm)	95-1/2 in (243 cm)
B	17 in (43 cm)	17 in (43 cm)	17 in (43 cm)
C	28-1/4 (72 cm)	27-1/2 in (70 cm)	26-3/4 in (68 cm)
D	67-1/2 in (171 cm)	66 in (168 cm)	64-1/2 in (164 cm)
OVERALL*	20 ft (6.10 m)	19 ft, 7 in (5.97 m)	19 ft, 2 in (5.85 m)

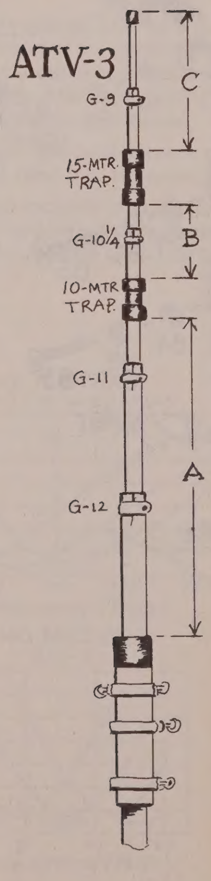
SECTION	CW	CENTER	PHONE
A	101 in (257 cm)	98-1/4 in (250 cm)	95-1/2 in (243 cm)
B	17 in (43 cm)	17 in (43 cm)	17 in (43 cm)
C	28-1/4 in (72 cm)	27-1/2 in (70 cm)	26-3/4 in (68 cm)
D	67 in (170 cm)	64 in (163 cm)	61 in (155 cm)
E 1	97 in (246 cm)	82 in (208 cm)	67 in (170 cm)
2	93 in (236 cm)	78 in (198 cm)	63 in (160 cm)
3	89 in (226 cm)	74 in (188 cm)	59 in (150 cm)
4	85 in (216 cm)	70 in (178 cm)	55 in (140 cm)
OVERALL*	28 ft, 4 in (8.64 m)	26 ft, 7 in (8.10 m)	24 ft, 9 in (7.55 cm)

*Average overall height, including base.

Not needed for PHONE
(Use #77 Cap)







Testing and Adjustment: After assembling and installing your Cushcraft vertical, check the SWR, using low power, to determine if it is tuned to the desired part of the band. There are apt to be slight variations, due to the mounting configuration and radial system, but except for 80 meters, and to a lesser extent 40 meters, these should not be of great consequence. Some variation from the typical SWR graphs should not seriously degrade performance. If the antenna does not exhibit a low SWR at the desired frequency; it can be adjusted by using the Nominal Dimensions Chart and the SWR curves as a guide. For example, adjusting the A dimension will affect 10 meters and, to a lesser extent, all lower frequencies. The B dimension, primarily affecting 15 meters, will not change 10 meters, but does have a small effect on the lower frequency bands.

TUNED RADIAL LENGTHS

BAND (Meters)	FREQUENCY (MHz)	LENGTH (Inches)	LENGTH (Feet and Inches)	LENGTH (Meters)
80	3.500	848	70' 8"	21.55
	3.750	792	66'	20.12
	4.000	742	61' 10"	18.86
40	7.000	424	35' 4"	10.78
	7.150	415	34' 7"	10.55
	7.300	407	33' 7"	10.33
20	14.000	212	17' 8"	5.39
	14.175	209-1/2	17' 5-1/2"	5.32
	14.350	207	17' 3"	5.26
15	21.000	141-1/2	11' 9-1/2"	3.59
	21.225	140	11' 8"	3.56
	21.450	138-1/2	11' 6-1/2"	3.52
10	28.000	106	8' 10"	2.69
	28.500	104-1/4	8' 8-1/4"	2.65
	29.000	102-1/2	8' 6-1/2"	2.60

TROUBLESHOOTING

Troubles that occur during operation may be isolated with the use of the chart on the following page. The SWR measurements should be made with a 50-ohm instrument that is accurately calibrated. The feedline and any other connections should be checked as possible causes of the problem. A 50-ohm dummy load can be substituted for the antenna to check the feedline and equipment.

TROUBLE	PROBABLE CAUSE	REMEDY
VSWR high or intermittent on 10-meters only; possibly noticeable change on 15-meters. (ATV-3/4/5)	10-meters ground system loose connection (s) or incorrect radial length. 10-meter trap has defective capacitor. trap.	Repair 10-meter ground connection(s) or reset radial length. Replace 10-meter trap.
VSWR high or intermittent on 15-meters only; possibly noticeable change on 20-meters. (ATV-3/4/5)	15-meter ground system has loose connection(s) or incorrect radial length. 15-meter trap has defective capacitor.	Repair 15-meter ground connection(s) or reset radial length. Replace 15-meter trap.
VSWR high or intermittent on 20-meters only; possibly noticeable change on 40-meters. (ATV-3/4/5)	20-meter ground system has loose connections or incorrect radial length. 20-meter trap (ATV-4/5) has defective capacitor.	Repair 20-meter ground connection(s), or reset radial length. Replace 20-meter trap.
VSWR high or intermittent on 40-meters only; possibly noticeable change on 80-meters. (ATV-4/5)	40-meter ground system has loose connection(s) or incorrect radial length. 40-meter trap (ATV-5) has defective capacitor.	Repair 40-meter ground connection(s), or reset radial length. Replace 40-meter trap.
VSWR high or intermittent on 80-meters only. (ATV-5)	80-meter ground system has loose connection(s) or incorrect radial length. 40-meter trap defective.	Repair 80-meter ground connection(s), or reset radial length. Replace 40-meter trap.
VSWR high or intermittent on all bands. (ATV-3/4/5)	Ground system has loose connections or incorrect radial lengths. Feed line or transmitter connection(s) faulty. 10-meter trap has defective inductor.	Repair ground connections or radial lengths. Repair or replace feedline or connection(s). Replace 10-meter trap.
VSWR high or intermittent on all bands, except 10-meters. (ATV-3/4/5)	15-meter trap defective. Ground system has loose connections or incorrect radial lengths, except on 10-meters.	Replace 15-meter trap. Repair ground connections or radial lengths.
VSWR high or intermittent on all bands, except 10-and 15-meters. (ATV-4/5)	20-meter trap defective. Ground system has loose connections or incorrect radial lengths, except on 10-and 15-meters.	Repair ground connections or radial lengths. Replace 20-meter trap.
VSWR high or intermittent on 40-and 80-meters (ATV-5)	40-meter trap defective. 40-and 80-meter ground system has loose connections or incorrect radial lengths.	Repair ground connections or radial lengths. Replace 40-meter trap.

LIMITED WARRANTY

CUSHCRAFT CORPORATION, P.O. BOX 4680, MANCHESTER, NEW HAMPSHIRE 03108, WARRANTS TO THE ORGINAL CONSUMER PURCHASER FOR ONE YEAR FROM DATE OF PURCHASE THAT EACH CUSHCRAFT ANTENNA IS FREE OF DEFECTS IN MATERIAL OR WORKMANSHIP. IF, IN THE JUDGEMENT OF CUSHCRAFT, ANY SUCH ANTENNA IS DEFECTIVE, THEN CUSHCRAFT CORPORATION WILL, AT ITS OPTION, REPAIR OR REPLACE THE ANTENNA AT ITS EXPENSE WITHIN THIRTY DAYS OF THE DATE THE ANTENNA IS RETURNED (AT PURCHASER'S EXPENSE) TO CUSHCRAFT OR ONE OF ITS AUTHORIZED REPRESENTATIVES. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESSED WARRANTIES, ANY IMPLIED WARRANTY IS LIMITED IN DURATION TO ONE YEAR. CUSHCRAFT CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM A DEFECT. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR EXCLUSIONS OR LIMITATIONS OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION AND EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. THIS WARRANTY DOES NOT EXTEND TO ANY PRODUCTS WHICH HAVE BEEN SUBJECT TO MISUSE, NEGLECT, ACCIDENT OR IMPROPER INSTALLATION. ANY REPAIRS OR ALTERATIONS OUTSIDE OF THE CUSHCRAFT FACTORY WILL NULIFY THIS WARRANTY.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

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ASSEMBLY INSTRUCTIONS

PROLINE FOUR POLES

PF - 457 D
PF - 156 D
PF - 167 D

SPECIFICATIONS

Specific Models

	PF-156D	PF-167D	PF-457D
Frequency Range	150-160 MHz	160-174 MHz	450-470 MHz
Height	24 Ft. (7.3m)	22 Ft. (6.7m)	8 Ft. (2.4m)
Weight	7 Lbs. (3.2kg)	7 Lbs. (3.2kg)	5 Lbs. 2.3kg)
Bandwidth	12 MHz	12 MHz	20 MHz
Wind Surface Area	2.56 Ft.^{2} (0.23m^2)	2.55 Ft.^{2} (0.23m^2)	1.12 Ft. ^{2} (0.10m^2)
Shipping Dimensions	50" x 5" x 5" (127cm x 13cm x 13cm)	50" x 5" x 5" (127cm x 13cm x 13cm)	36" x 5" x 5" (91cm x 13cm x 13cm)

All Models

Gain	6dBd omni	9dBd offset
Nominal Impedance		50 ohms
VSWR		1.5 - 1 maximum
Power Handling		1000 watts
Wind Survival		100mph (160kmh)
Lightning Protection		DC ground
Materials		6063 - T832, seamless hard drawn aluminum tubing
Termination		UHF connector, accepts PL - 259

All models ship by parcel service.

PARTS LIST

DESCRIPTION	QUANTITY
Dipole assembly with Reddi Match	4
Mounting boom 1" (2.5cm) aluminum tubing	4
Coax stacking harness	1

PARTS PACKAGE

PART#	DESCRIPTION	QUANTITY PF-156/167D	PF-457D
5	5/16"(.8cm) Lock washer	8	8
6	5/16"(.8cm) Hex nut	8	8
31	2"x4"(5.1x10.1cm) U-bolt	4	4
32	3-1/2"(8.9cm) Formed aluminum U-bolt bracket	4	4
33	3-1/2"(8.9cm) Aluminum U-bolt backing plate	4	4
12	3/4"(1.9cm) Black plastic cap	8	0
53	1/2"(1.3cm) Black plastic cap	0	8
61	7/8"(2.2cm) Black plastic cap	8	8

INSTALLATION SUGGESTIONS

Your Cushcraft Four Pole is designed and manufactured to give top performance and trouble free service. The antenna will perform as specified if the instructions and suggestions are followed and if care is used in assembly and installation.

MASTING: The mast mount brackets will take up to a 2" O.D. mast. For protected installations where severe wind and weather will not be encountered a 1-1/4" O.D. steel television type tubing will be satisfactory. At remote exposed locations where wind and ice loading will be encountered a heavy wall 2" O.D. steel or aluminum mast should be used. The PF-156D requires 24' of masting, the PF-167D-22', and the PF-457D-8'.

LOCATIONS: Separation between the Four Pole and another transmit or receive antenna at the same repeater site should be 20 to 30 feet minimum. Two Four Poles may be used or the antenna may be used in conjunction with the CRX-150 or the CRX-450 Ringo omnidirectional antennas.

WARNING: THIS ANTENNA IS AN ELECTRICAL CONDUCTOR, CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION, REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. FOLLOW THE GUIDELINES FOR ANTENNA INSTALLATION RECOMMENDED BY THE U.S. CONSUMER PRODUCT SAFETY COMMISSION AND LISTED IN THE ENCLOSED PAMPHLET.

ASSEMBLY: The Reddi Match units are factory assembled on the dipoles. Assemble the dipoles on the support booms as shown in Figure 1.

Mount the assemblies to the center mast or tower using the 2" x 4" U-bolts as shown in Figure 1. Keep all Reddi Match rods pointing in the same direction. The maximum tower cross section should not exceed 24". The mast or tower leg should be directly in back of the dipoles. The top dipole should be mounted 5" down from the top of the mast or tower.

The tip-to-tip vertical dipole spacing should be:

PF 156D	35 3/4"	(90.8cm)
PF 167D	33"	(83.8cm)
PF 457D	12 7/8"	(31.9cm)

For a uniform 360° pattern with 6 dBd gain space the dipoles equally around the mast or tower, with each dipole 90° from the dipoles above and below it.

For a semi directional pattern with 9 dBd gain mount the dipoles in line on one side of the mast. Gain at 100° either side of center will be 5 dBd. Gain directly in back of the antenna will be 1.5 dBd.

TUNING: The Reddi Match units are preset. In most installations no tuning will be required. If you do find it necessary to tune follow the procedure outlined below for each dipole.

(1) Insert a good quality standing wave bridge in the 50-ohm line between the signal source and the dipole.

(2) Adjust the bridge for maximum forward power. Check the standing wave ratio with the bridge in the reverse position. If the VSWR is high loosen the tuning strap and adjust it slightly in either direction. Move away from the antenna and check the reading. If the VSWR has increased move the strap back to its original position and adjust in the opposite direction. If the VSWR dropped repeat the adjustment procedure until there is little or no reflected power indicated on the bridge.

After tuning or checking the dipoles connect the coaxial phasing harness as illustrated in Figure 2. Connect your 50-ohm feed cable to the center connector, Figure 2. Dress the cables along the booms and down the mast, using tape to hold it in position. Re-check and tighten all fasteners and connections.

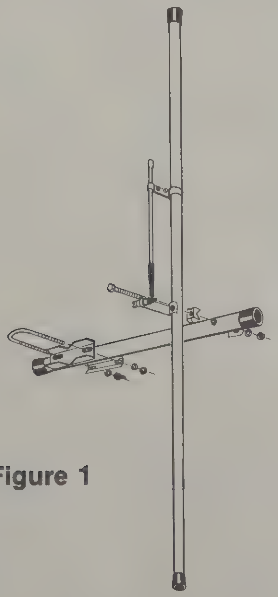


Figure 1

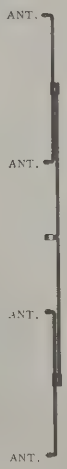
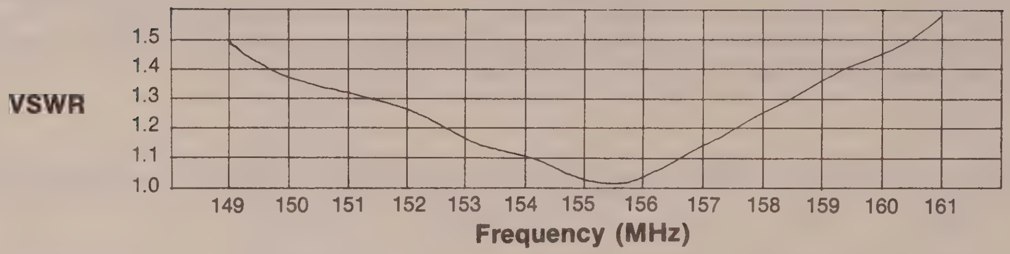


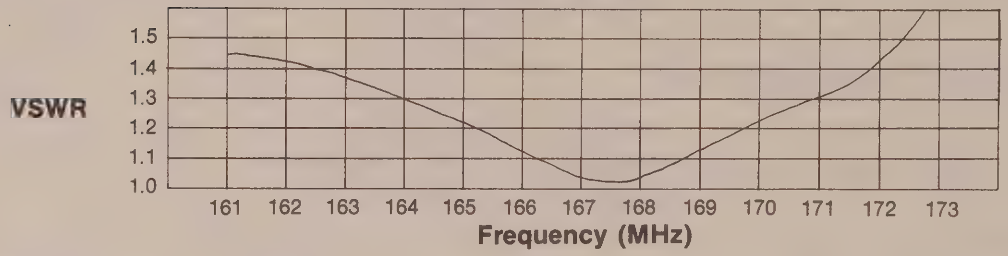
Figure 2

TYPICAL VSWR GRAPHS

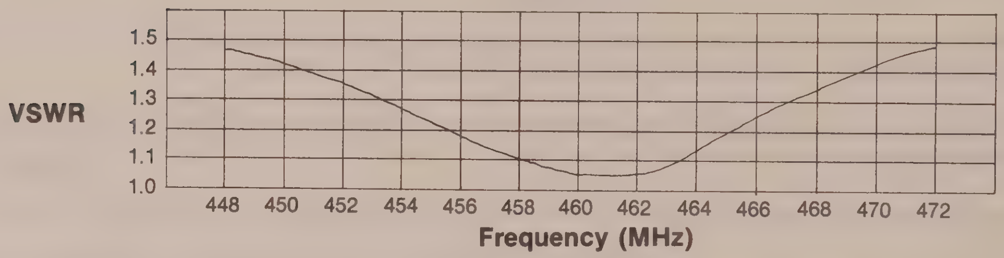
PF-156D



PF-167D



PF-457D



Stacking Information

Four poles may be mounted alone or in combination with other four pole antennas to achieve a variety of radiation patterns. Five of these methods and the resulting patterns are shown below.

VERTICAL STACKING INFORMATION

Required Mast and Harness

Model	Mast (2 antennas)	Harness Model #
PF-156D	48'(14.6m)	P156-VK
PF-167D	44'(13.4m)	P167-VK
PF-457D	16'(4.8m)	P457-VK

HORIZONTAL STACKING INFORMATION

Required Mast and Harnesses

Model	Mast (2 antennas)	Harness Model #
PF-156D	24'(7.3m)	P156-DK
PF-167D	22'(6.7m)	P167-DK
PF-457D	8'(2.4m)	P457-DK

ASSEMBLY AND INSTALLATION INSTRUCTION FOR
PF-134DA, PF-156DA, PF-167DA,
PF-457DA, PF-479DA, PF-492DA, PF8-457DA

PARTS LIST

PART #	DESCRIPTION	QUANTITY
	Dipole with Reddi Match assembled on 7/8" booms	4
	Coax stacking harness	1

PARTS PACKAGE

020142	4 1/4 X 2 3/8" (10.8 X 6cm) steel U-bolt	4
020006	5/16" (7.9mm) steel hex nut	8
020005	5/16" (7.9mm) steel split lock washer	8
190033	3 1/2" (8.89cm) aluminum U-bolt backing plate	4
190032	3 1/2" (8.89cm) formed aluminum U-bolt bracket	4
050061	7/8" (22.2mm) black plastic cap	8
050053	1/2" (12.7mm) black plastic cap	8
240116	Silicone grease package	3
290326	Warning label	1
050115	Connector Boot	1

ASSEMBLY

The Four Pole dipoles with Reddi Match are factory assembled on the booms. Mount the assembled units to the mast or tower using the 2 3/8" x 4 1/4" U-bolts as shown in Figure 1, with all Reddi Match rods pointing down on PF-134DA, PF-156DA and PF-167DA models; and with all Reddi Match rods pointing up on PF-456DA, PF-479DA, PF-492DA and PF8-45DA models. The mast or tower should extend 5 inches above the top dipole element. When mounting on a tower, the cross section of the tower should not exceed 24 inches.

The tip-to-tip vertical spacing should be:

PF-134DA	42 1/2"	(107.9cm)
PF-156DA	35 3/4"	(90.8cm)
PF-167DA	33"	(83.8cm)
PF-457DA	12 7/8"	(31.9cm)
PF-479DA	12 1/4"	(31.1cm)
PF-492DA	11 3/4"	(29.8cm)
PF8-457DA	12 7/8"	(31.9cm)

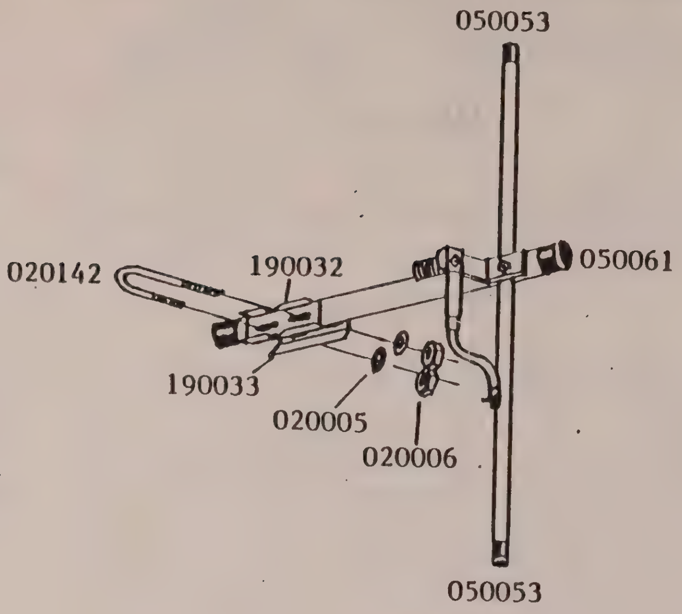
The boom-to-boom vertical spacing should be:

PF-134DA	85"	(215.8cm)
PF-156DA	71 1/2"	(181.6cm)
PF-167DA	66"	(167.6cm)
PF-457DA	25 3/4"	(63.8cm)
PF-479DA	24 1/2"	(62.2cm)
PF-492DA	23 1/2"	(59.6cm)
PF8-457DA	25 3/4"	(63.8cm)

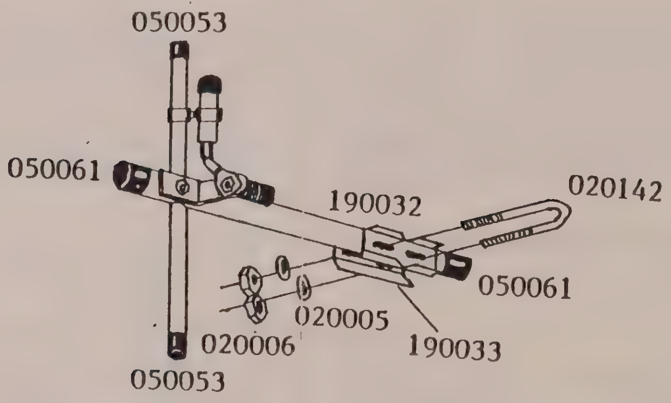
TUNING PROCEDURE

PF-series antennas are broadband. The PF-134DA covers 132-143 MHz, the PF-156DA covers 150-160 MHz and the PF-167DA covers 160-170 MHz; the PF-457DA and PF8-457DA cover 450-470 MHz, the PF-479DA covers 470-490 MHz and the PF-492DA covers 490-512 MHz. There is no need to field-tune any of these antennas.

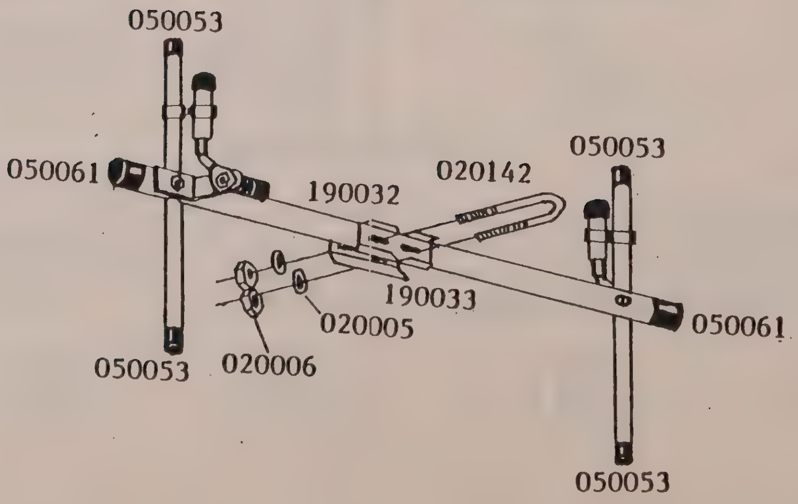
PF-134DA, PF-156DA, PF-167DA



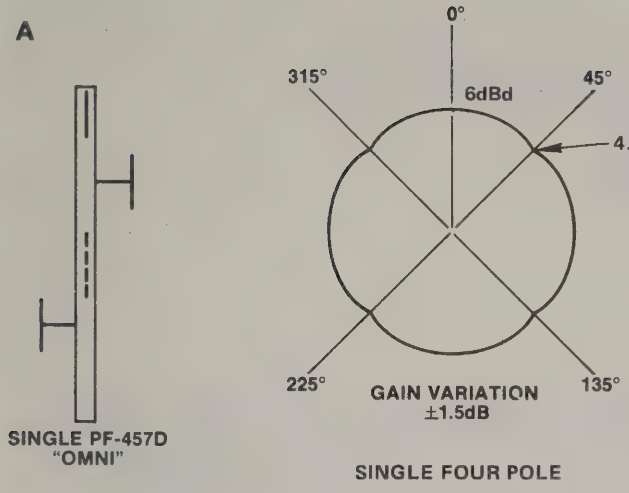
PF-457DA, PF-479DA, PF-492DA



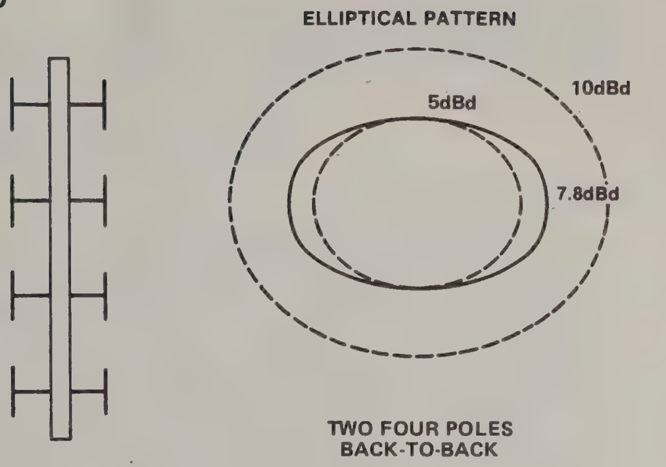
PF8-457DA



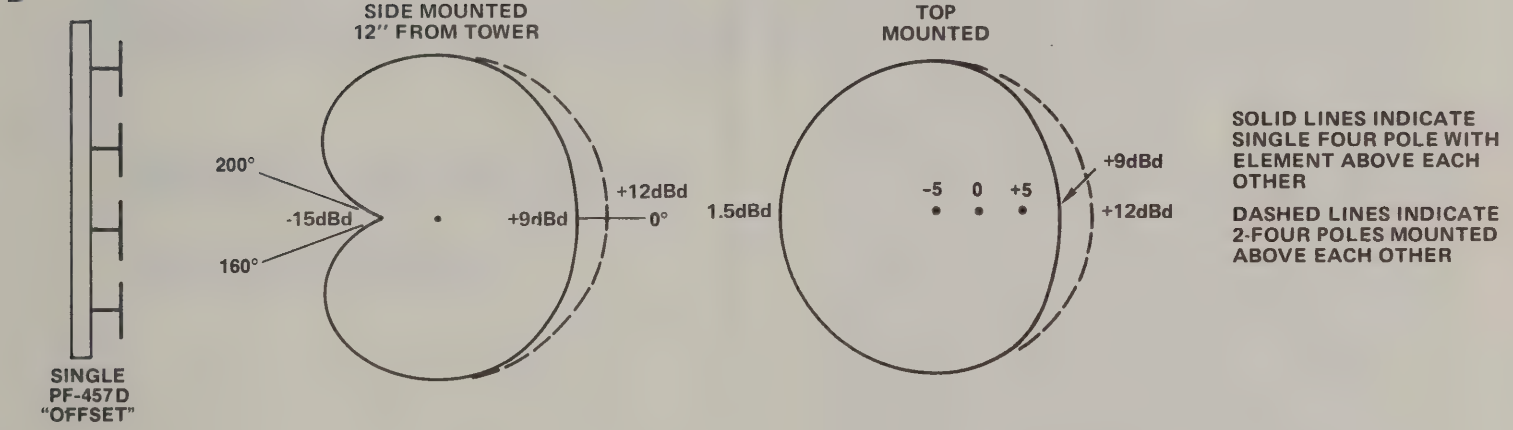
A


0°
315°
45°
6dBd
4.5dBd
225°
135°
GAIN VARIATION
±1.5dB
SINGLE PF-457D
"OMNI"
SINGLE FOUR POLE

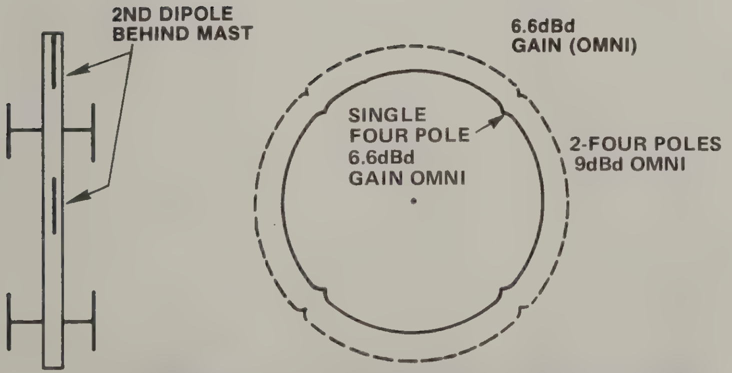
D


ELLIPTICAL PATTERN
10dBd
5dBd
7.8dBd
TWO FOUR POLES
BACK-TO-BACK

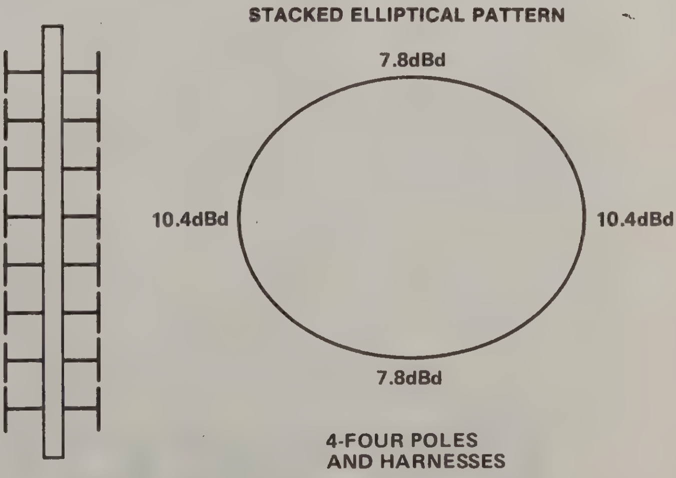
B


SIDE MOUNTED
12" FROM TOWER
200°
-15dBd
+9dBd
+12dBd
0°
160°
SINGLE
PF-457D
"OFFSET"
TOP
MOUNTED
1.5dBd
-5
0
+5
+9dBd
+12dBd
SOLID LINES INDICATE
SINGLE FOUR POLE WITH
ELEMENT ABOVE EACH
OTHER
DASHED LINES INDICATE
2-FOUR POLES MOUNTED
ABOVE EACH OTHER

C


2ND DIPOLE
BEHIND MAST
6.6dBd
GAIN (OMNI)
SINGLE
FOUR POLE
6.6dBd
GAIN OMNI
2-FOUR POLES
9dBd OMNI

E


STACKED ELLIPTICAL PATTERN
7.8dBd
10.4dBd
10.4dBd
7.8dBd
4-FOUR POLES
AND HARNESSES

LIMITED WARRANTY

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SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

ASSEMBLY AND INSTALLATION INSTRUCTIONS

CRX-150B
CRX-450B
CRX-470B
CRX-490B

RINGO RANGER II ANTENNAS

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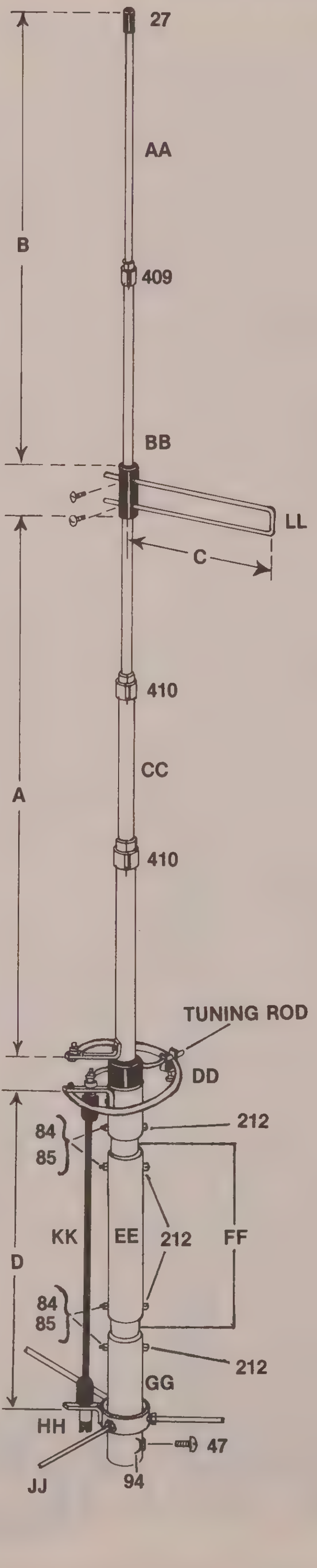
CORPORATION

CRX-150B684

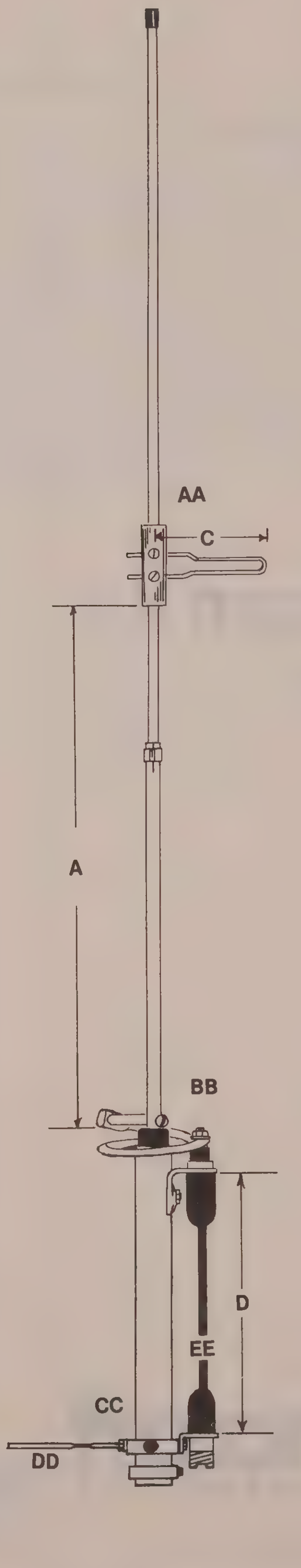
1A

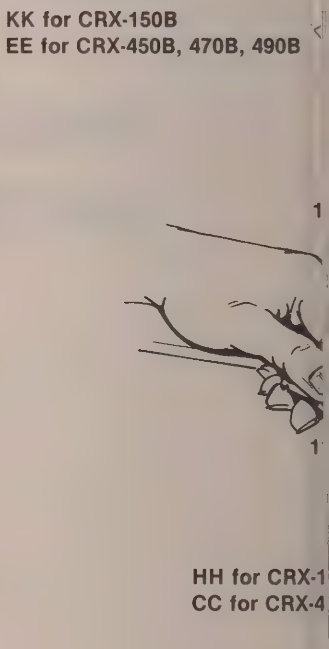
CRX-150B



1B

CRX-450B, CRX-470B
CRX-490B





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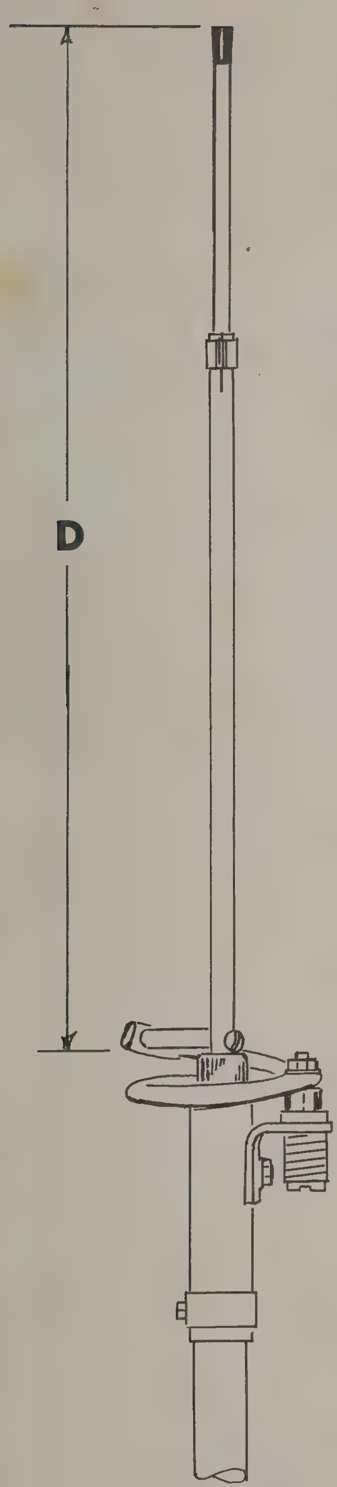
ASSEMBLY – INSTALLATION INSTRUCTIONS

CR-450 CR-470 CR-490 CRX-450 CRX-470 CRX-490



INSTALLATION SUGGESTIONS

Your Cush Craft Ringo or Ringo Ranger is designed and manufactured to give top performance and trouble-free service. It will perform as specified, if the assembly and installation instructions are carefully followed.

MASTING: The antennas will take up to a 1" O.D. mast. Mount the antenna as high and in the clear as possible. When tower side mounting keep the antenna at least 1/4 wavelength out from the tower.

LOCATION: This is very important. Surrounding objects such as trees, power lines, other antennas etc., will seriously reduce efficiency. To minimize the effect of surrounding objects, mount the antenna as high and in the clear as possible.

ASSEMBLY:

CR- Antennas: Slide the uncapped end of the 3/8" O.D. tubing section into the 1/2" base section. Adjust the overall length, Dimension B, from Chart 1. Tighten with the 1/2" telescope clamp.

CRX- Antennas: Slide the uncapped end of the 3/8" tubing section into the 1/2" base section and adjust Dimension A from Chart 1. Tighten with the 1/2" telescope clamp. Adjust the phasing stub, Dimension C to 2 7/8". Tighten with the two 8 - 32" x 1/2" machine screws.

TUNING INSTRUCTIONS:

Use a good quality 52-ohm coaxial cable with a PL-259 connector. When tuning mount the antenna as high and in the clear as possible. Use a good quality standing wave ratio bridge. It is preferable to mount the bridge at the antenna for tuning. Set the transmitter to your center operating frequency. Adjust the transmitter and bridge for maximum forward power. Check the standing wave ratio or reflected power with the bridge in the reverse position. Move away from the antenna when making measurements.

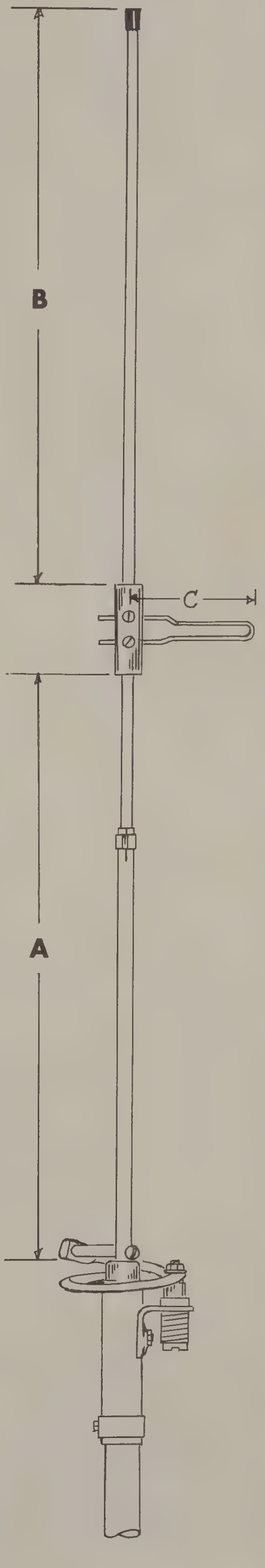
If the SWR is high, loosen the 1/2" telescope clamp on the lower section, and adjust the 3/8" section slightly in either direction. If the SWR increased, move the 3/8" section back to its original position and adjust in the opposite direction. If the SWR dropped, repeat the adjustment procedure until there is little or no reflected power indicated on the bridge.

When the antenna is completely assembled, and tuned tape the feed line connections, and coat with a clear acrylic spray or equal. Run the coaxial feed line down the mast and use tape to hold it in position.

MODEL	FREQUENCY RANGE MHz	CENTER FREQUENCY MHz
CR-450	450 - 470	460
CR-470	470 - 490	480
CR-490	490 - 512	501
CRX-450	450 - 470	460
CRX-470	470 - 490	480
CRX-490	490 - 512	501

CHART # 1

DIM.	CRX - 450	CRX - 470	CRX - 490
A	16 1/2"	15 7/8"	15 1/4"
B	16"	15 3/8"	14 3/4"
C	2 7/8"	2 7/8"	2 7/8"
	CR - 450	CR - 470	CR - 490
D	12"	11 1/2"	11 1/6"



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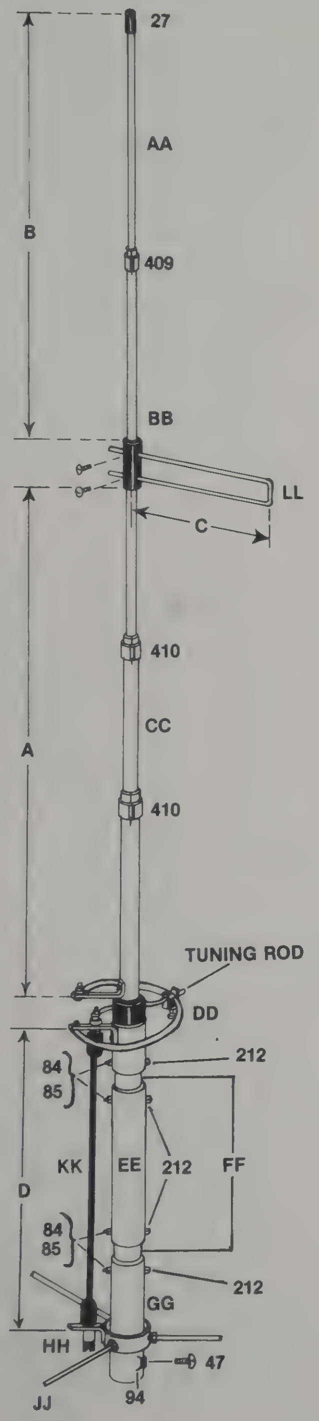
P.O. BOX 4680, MANCHESTER, N.H. 03108

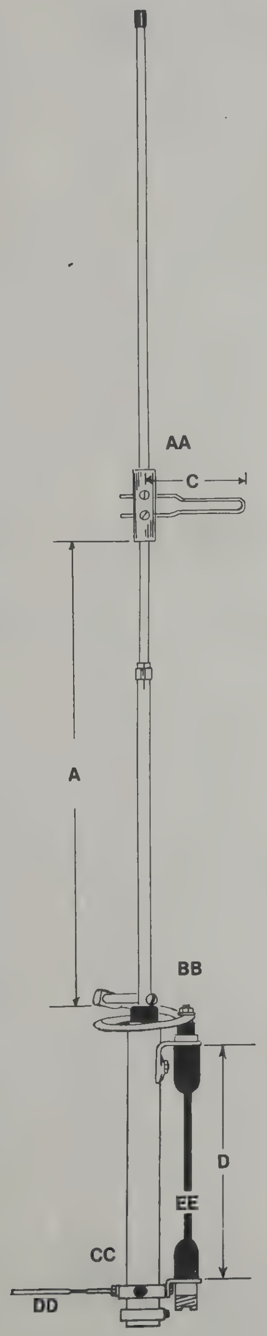
1A

CRX-150B



1B

CRX-450B, CRX-470B
CRX-490B



2

RADIAL RING ASSEMBLY

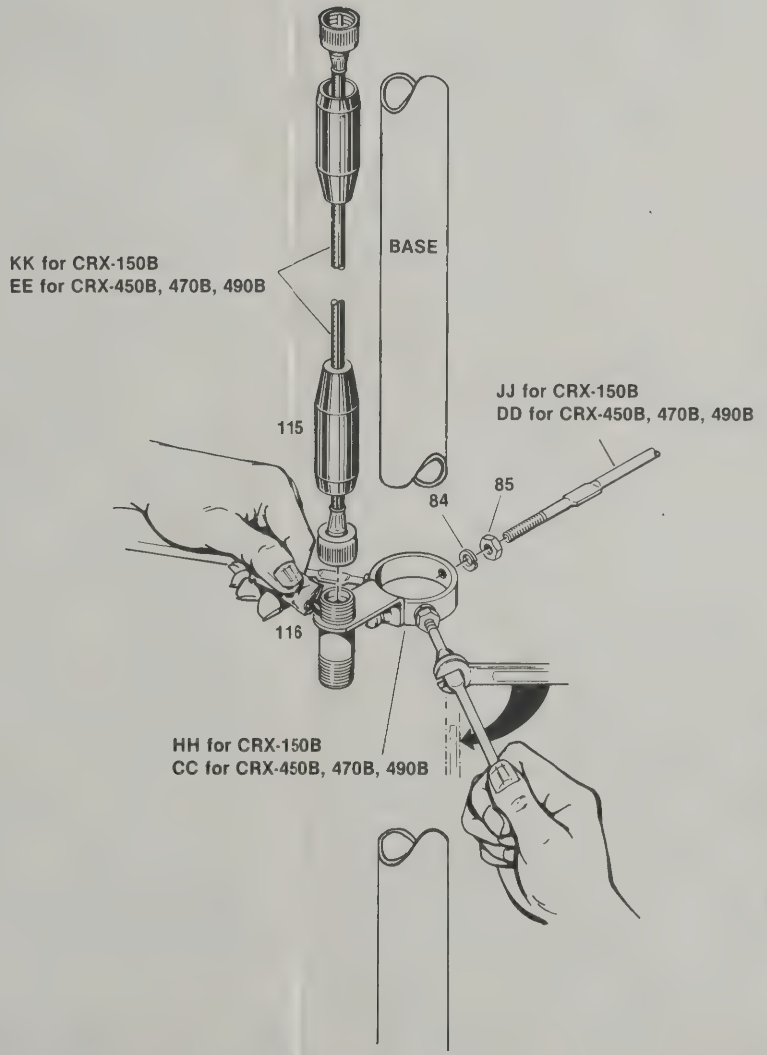

BASE
KK for CRX-150B
EE for CRX-450B, 470B, 490B
115
JJ for CRX-150B
DD for CRX-450B, 470B, 490B
85
84
116
HH for CRX-150B
CC for CRX-450B, 470B, 490B

CHART 1A

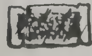
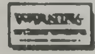
DIM	CRX-150B	CRX-450B	CRX-470B	CRX-490B
A		16-1/2"	15-7/8"	15-1/4"
C		2-7/8"	2-7/8"	2-7/8"
D	48-1/4"	18-1/2"	18-1/2"	17-1/2"

CHART 1B

FREQUENCY (MHz)	DIM A	DIM B	DIM C
146	55"	50-1/4"	9"
148	54-1/4"	49-1/2"	8-7/8"
150	53-1/2"	48-3/4"	8-3/4"
152	52-3/4"	48"	8-5/8"
154	52"	47-1/4"	8-5/8"
156	51-1/4"	46-1/2"	8-1/2"
158	50-1/2"	46"	8-3/8"
160	50"	45-1/2"	8-1/4"
162	49-1/4"	45"	8-1/4"
164	48-3/4"	44-1/2"	8-1/8"
166	48"	44"	8"
168	47-1/2"	43-1/2"	7-7/8"
170	47"	43"	7-7/8"
172	46-1/2"	42"	7-3/4"
174	46"	41-1/2"	7-5/8"

MODEL	FREQUENCY RANGE MHz	CENTER FREQUENCY MHz
CRX-150B	146-174	160
CRX-450B	450-470	460
CRX-470B	470-490	480
CRX-490B	490-512	501

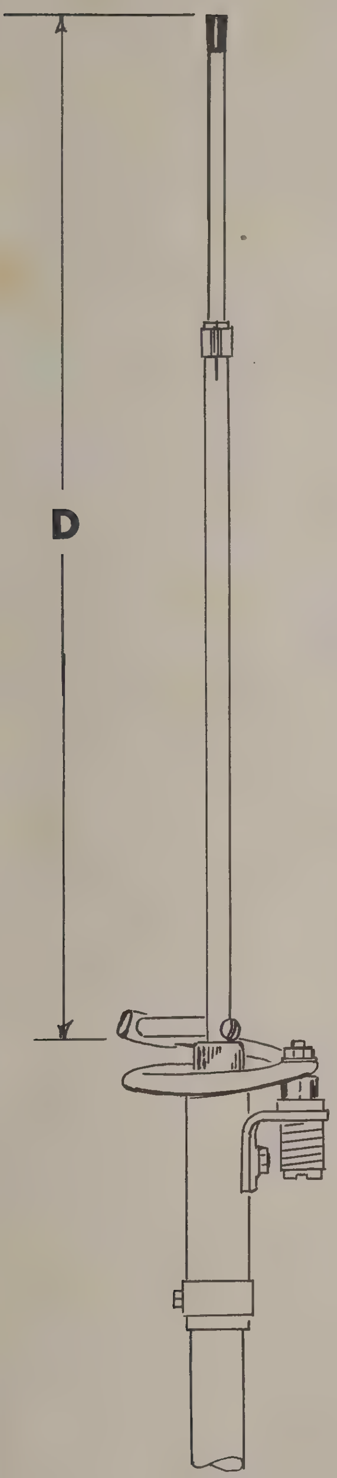
PARTS PACKAGE CRX-450B, CRX-470B and CRX-490B

PART #	KEY	DETAIL	DESC.	SIZE	QTY.
010085	85		HEX NUT	1/4" – 20 (0.64cm)	3
010084	84		SPLITLOCK WASHER	1/4" (0.64cm)	3
050115	115		VINYL BOOT		1
240116	116		SILICONE	—	3
290326	500		WARNING LABEL		1

cushcraft CORPORATION

ASSEMBLY – INSTALLATION INSTRUCTIONS

CR-450 CR-470 CR-490 CRX-450 CRX-470 CRX-490



INSTALLATION SUGGESTIONS

Your Cush Craft Ringo or Ringo Ranger is designed and manufactured to give top performance and trouble-free service. It will perform as specified, if the assembly and installation instructions are carefully followed.

MASTING: The antennas will take up to a 1" O.D. mast. Mount the antenna as high and in the clear as possible. When tower side mounting keep the antenna at least 1/4 wavelength out from the tower.

LOCATION: This is very important. Surrounding objects such as trees, power lines, other antennas etc., will seriously reduce efficiency. To minimize the effect of surrounding objects, mount the antenna as high and in the clear as possible.

ASSEMBLY:

CR- Antennas: Slide the uncapped end of the 3/8" O.D. tubing section into the 1/2" base section. Adjust the overall length, Dimension B, from Chart 1. Tighten with the 1/2" telescope clamp.

CRX- Antennas: Slide the uncapped end of the 3/8" tubing section into the 1/2" base section and adjust Dimension A from Chart 1. Tighten with the 1/2" telescope clamp. Adjust the phasing stub, Dimension C to 2 7/8". Tighten with the two 8 - 32" x 1/2" machine screws.

TUNING INSTRUCTIONS:

Use a good quality 52-ohm coaxial cable with a PL-259 connector. When tuning mount the antenna as high and in the clear as possible. Use a good quality standing wave ratio bridge. It is preferable to mount the bridge at the antenna for tuning. Set the transmitter to your center operating frequency. Adjust the transmitter and bridge for maximum forward power. Check the standing wave ratio or reflected power with the bridge in the reverse position. Move away from the antenna when making measurements.

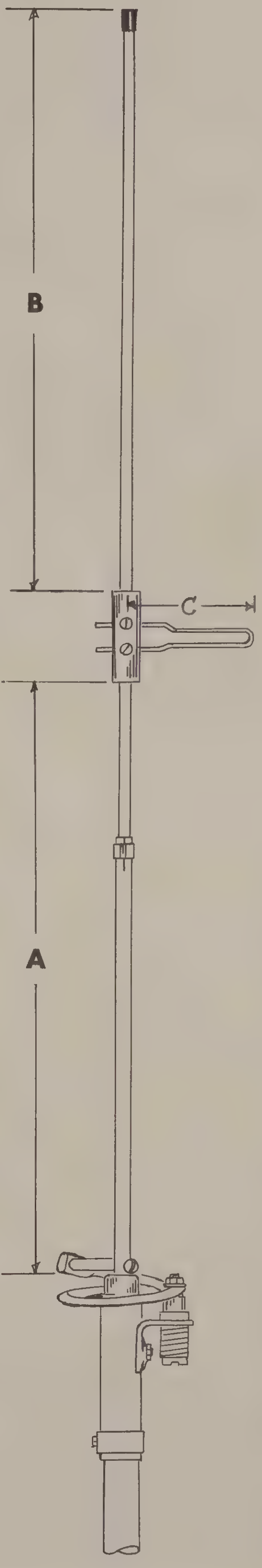
If the SWR is high, loosen the 1/2" telescope clamp on the lower section, and adjust the 3/8" section slightly in either direction. If the SWR increased, move the 3/8" section back to its original position and adjust in the opposite direction. If the SWR dropped, repeat the adjustment procedure until there is little or no reflected power indicated on the bridge.

When the antenna is completely assembled, and tuned tape the feed line connections, and coat with a clear acrylic spray or equal. Run the coaxial feed line down the mast and use tape to hold it in position.

MODEL	FREQUENCY RANGE MHz	CENTER FREQUENCY MHz
CR-450	450 - 470	460
CR-470	470 - 490	480
CR-490	490 - 512	501
CRX-450	450 - 470	460
CRX-470	470 - 490	480
CRX-490	490 - 512	501

CHART # 1

DIM.	CRX - 450	CRX - 470	CRX - 490
A	16 1/2"	15 7/8"	15 1/4"
B	16"	15 3/8"	14 3/4"
C	2 7/8"	2 7/8"	2 7/8"
	CR - 450	CR - 470	CR - 490
D	12"	11 1/2"	11 1/6"



cushcraft CORPORATION

P.O. BOX 4680, MANCHESTER, N.H. 03108

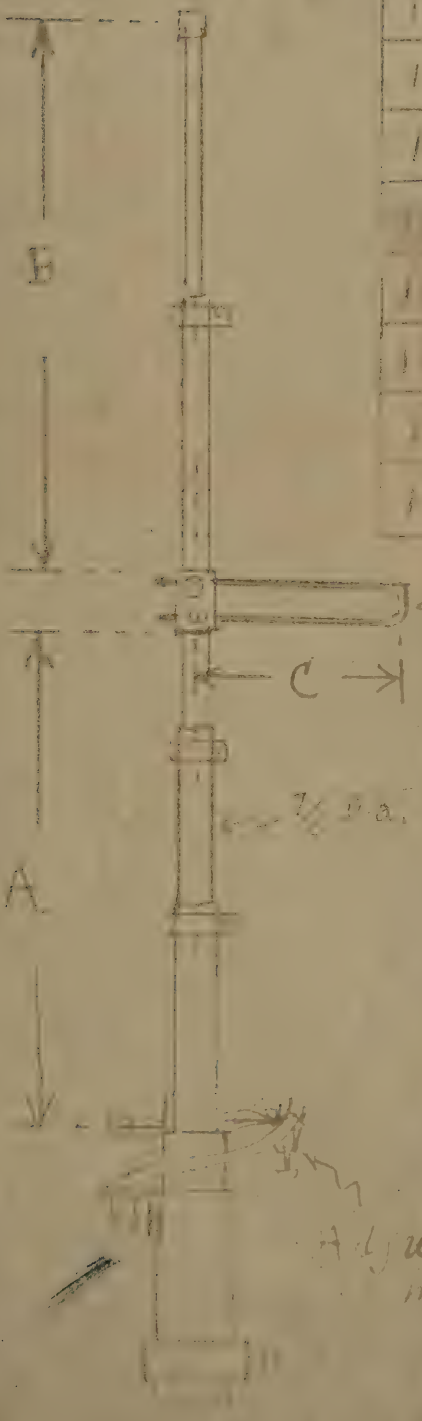
CRX-150 HIGH-BAND RINGO RANGER ANTENNA

Cush Craft

CHART 1

26 August, 1974 - D.P.C.

FREQUENCY (MHZ)	DIMENSIONS A	B	C	½ WAVE LENGTH
145	55½"	50½"	9"	38¼"
147	54¾"	49¾"	8⅞"	37⅝"
150	53½"	48¾"	8¾"	37"
152	52¾"	48"	8⅝"	36½"
155	51¾"	47"	8½"	35¾"
157	51"	46¼"	8⅜"	35¼"
160	50"	45½"	8¼"	34⅝"
162	49½"	45"	8⅛"	34⅛"
165	48½"	44"	8"	[illegible]½"
167	48"	43½"	7⅞"	[illegible]3⅛"
170	47"	42¾"	7¾"	32½"

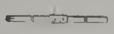
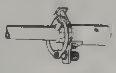
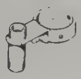
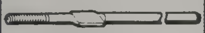
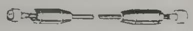


Phasing Stub.

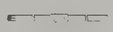
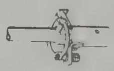
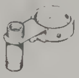
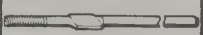
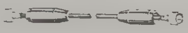
The antenna may be used as a ½ wave Ringo by removing all sections above the ⅞" Section. Turn the ⅞" Section upside-down and adjust so that the radiator is ½ wave length from the Chart, measured from the top of the Ringo Base Insulator to the tip of the Antenna

Adjust [illegible] Clamp for minimum SWR

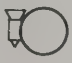
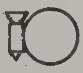
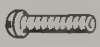
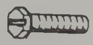
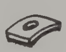
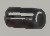
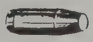
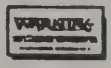
PARTS LIST CRX-450B AND CRX-470B

KEY	DETAIL	DESC.	SIZE	QTY.
AA		TIP SECTION AND PHASING STUB	—	1
BB		BASE AND RING ASSEMBLY	—	1
CC		RADIAL RING ASSEMBLY		1
EE		RADIALS	6 1/2x1/4" (16.5x0.64cm)	3
EE		PHASING CABLE	16 3/8" (41.6cm)	1

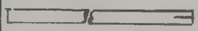
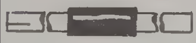
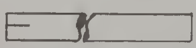
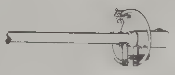
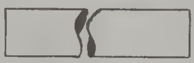
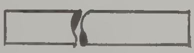
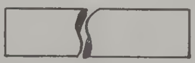
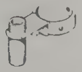
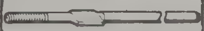
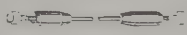
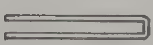
PARTS LIST CRX-490B

KEY	DETAIL	DESC.	SIZE	QTY.
AA		TIP SECTION AND PHASING STUB	—	1
BB		BASE AND RING ASSEMBLY	—	1
CC		RADIAL RING ASSEMBLY		1
DD		RADIALS	6"x 1/4" (15.2x0.64cm)	3
EE		PHASING CABLES	15 3/8" (31.9cm)	1

PARTS PACKAGE CRX-150B

PART #	KEY	DETAIL	DESC.	SIZE	QTY.
030409	409		WORM CLAMP	3/4" (1.91cm)	1
030410	410		WORM CLAMP	1" (2.54cm)	2
020047	47		MACHINE SCREW	1/4" – 20x3/4" (1.91cm)	1
010212	212		HEX MACHINE SCREW	1/4" – 20x2" (5.08cm)	4
010084	84		SPLITLOCK WASHER	1/4" (0.64cm)	7
010085	85		HEX NUT	1/4"x20 (0.64cm)	7
020249	94		LOCK NUT	1/4"x20 (0.64cm)	1
050027	27		PLASTIC CAP	5/8" (1.59cm)	1
050115	115		VINYL BOOT	—	1
240116	116		SILICONE	—	3
290326	500		WARNING LABEL	—	1

PARTS LIST CRX-150B

KEY	DETAIL	DESC.	SIZE	QTY.
AA		TUBING	36"x5/8" (91.4x1.6cm)	1
BB		PHASING SECTION	35"x3/4" (88.9x1.9cm)	1
CC		TUBING	24"x7/8" (60.9x2.2cm)	1
DD		BASE AND RING ASSEMBLY	—	1
EE		TUBING	23 1/4"x1 1/2" (59.7x3.8cm)	1
FF		TUBING	8"x1 3/8" (20.3x3.5cm)	2
GG		TUBING	22"x1 1/2" (55.9x3.8cm)	1
HH		RADIAL RING ASSEMBLY	1 7/8" (4.8cm)	1
JJ		RADIALS	20 1/2"x1/4" (52.1x0.64cm)	3
KK		PHASING CABLE	48 1/4" (123.2cm)	1
LL		PHASING STUB	9 3/4" (24.8cm)	1

Your Cushcraft Ringo Ranger II is designed and manufactured to give top performance and trouble free service. It will perform as specified, if the assembly and installation instructions are carefully followed. Figures 1A and 1B are your overall assembly guide.

LOCATION

This is very important. Surrounding objects such as trees, power lines, other antennas, etc., will seriously reduce efficiency. To minimize the effect of surrounding objects, mount the antenna as high and in the clear as possible. If metal guy wires are used, they should be broken with strain insulators. WARNING: THIS ANTENNA IS AN ELECTRICAL CONDUCTOR, CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION, REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. FOLLOW THE GUIDELINES FOR ANTENNA INSTALLATIONS RECOMMENDED BY THE U.S. CONSUMER PRODUCT SAFETY COMMISSION AND LISTED IN THE ENCLOSED PAMPHLET. Plan your installation carefully. If you use volunteer helpers be sure that they are qualified to assist you. Make certain that everyone understands that you are the boss and that they must follow your instructions.

MASTING

The CRX-150B will take up to a 1¼″ (3.18 cm) O.D. mast, and the CRX-450B, CRX-470B and CRX-490B will take up to a 7/8″ (2.2 cm) O.D. mast. Mount the antenna as high and in the clear as possible. When tower-side mounting, keep the antenna at least ¼ wavelength (the length of one of the radial rods) out from the tower.

ASSEMBLY

1. For CRX-150B (refer to figure 1A) assemble the lower antenna support sections (EE, FF, and GG) to the BASE AND RING ASSEMBLY (DD).
2. Assemble the radiator sections. For the CRX-150B slide the 7/8″ (2.2 cm) tube (CC); into the 1″ (2.54 cm) and of the BASE AND RING ASSEMBLY (DD). Tighten securely with a 1″ (2.54 cm) WORM CLAMP (410). Slide the PHASING SECTION (BB), non-slotted end into the 7/8″ (2.2 cm) tube (CC). Adjust DIMENSION A to the proper length for your operating frequency from CHART 1B. Tighten securely with a 1″ (2.54 cm) WORM CLAMP (410). Slide the 5/8″ (1.6 cm) tube (AA) into the top of the PHASING SECTION (BB). Adjust to the proper length for your operating frequency DIMENSION B, CHART 1B. Tighten securely with the ¾″ (1.91 cm) WORM CLAMP (409). Press the PLASTIC CAP (27) over the exposed end of the 5/8″ (1.6 cm) tube (AA). Slide the PHASING STUB (LL) through the pre-drilled holes in the fiberglass insulator. Adjust to DIMENSION C for your operating frequency from CHART 1B. Tighten the 8-32 screws securely. They may fit tight as they self thread through the aluminum tubing. FOR CRX-450B, CRX-470B and CRX-490B (refer to FIGURE 1B), slide the uncapped end of the TIP SECTION AND PHASING STUB (AA) into the ½″ (1.27 cm) end of the BASE AND RING ASSEMBLY (BB) and adjust to DIMENSION A from CHART 1A. Tighten securely with the ½″ (1.27 cm) WORM CLAMP. Adjust the PHASING STUB to DIMENSION C from CHART 1A and tighten with the two 8-32 x ½″ (1.27 cm) MACHINE SCREWS.
3. Mount the RADIAL RING ASSEMBLY (HH for CRX-150B and CC for CRX-450B, CRX-470B and CRX-490B) to the BASE as shown in FIGURE 2 using the RADIALS (JJ for CRX-150B and DD for CRX-450B, CRX-470B and CRX-490B) ¼″ (.64 cm) LOCK WASHERS (84) and ¼″ x 20 (.64 cm) HEX NUTS (85) to secure it. Adjust it to DIMENSION D FROM CHART 1A for the antenna which you are assembling.
4. Connect the RG-8/U PHASING CABLE (KK for CRX-150B and EE for CRX-450B, CRX-470B, and CRX-490B) between the two COAXIAL FITTINGS (FIGURE 2). Connect the COAXIAL FEEDLINE from the radio to the LOWER COAXIAL FITTING in the same way in which you connected the PHASING CABLE CONNECTIONS. Use the VINYL BOOTS (115) and SILICONE (116) provided to protect the connectors. Apply the SILICONE (116) to the outside threads only. DO NOT APPLY TO CENTER PIN.
5. For CRX-150B mounting, place the ¼″-20 ¾″ (1.91 cm) MACHINE SCREW (47) through the hole in the lower base section, thread it through the ¼″-20 (.64 cm) LOCK NUT (94), and tighten the screw against your support mast.

TUNING

When tuning, mount the antenna as high and in the clear as possible. Use a good quality standing wave ratio bridge. It is preferable to mount the bridge at the antenna for tuning. Set the transmitter to your center operating frequency. Adjust the transmitter and bridge for maximum power. Check the standing Wave Ratio (SWR), reflected power, with the bridge in the reverse position. Move away from the antenna when making measurements.

FOR CRX-150B

If the SWR is high, loosen the tuning rod clamp and adjust the rod slightly in either direction. If the SWR increased, move the rod back to its original position and adjust in the opposite direction. If the SWR dropped, repeat the adjustment procedure until there is little or no reflected power indicated on the bridge. Tighten the tuning rod clamp securely.

FOR CRX-450B, CRX-470B, and CRX-490B

If the SWR is high, loosen the ½″ (1.27 cm) WORM CLAMP on the lower section, and adjust the 3/8″ (.95 cm) section slightly in either direction. If the SWR increased, move the 3/8″ (.95 cm) section back to its original position, and adjust in the opposite direction. If the SWR dropped, repeat the adjustment procedure until there is little or no reflected power indicated on the bridge.

WHEN THE ANTENNA IS COMPLETELY ASSEMBLED AND TUNED, TAPE THE FEEDLINE INTO POSITION AGAINST THE MAST.

ASSEMBLY: The Reddi Match units are factory preassembled on the dipoles. Assemble the dipoles on the support booms as shown in figure 1.

Mount the assemblies to the center mast or tower using the 2" x 4" u-bolts as shown in figure 1. Keep all Reddi Match rods pointing in the same direction. The maximum tower cross section should not exceed 24". The mast or tower leg should be directly in back of the dipoles. The top dipole should be mounted 5" down from the top of the mast or tower.

Vertical spacing between the dipoles should be: AFM-4D - 38", AFM-24D - 24 7/8", AFM-44D - 12".
PF-156D 35 - 3/4"

For a uniform 360° pattern with 6 db gain space the dipoles equally around the mast or tower, with each dipole 90° from the dipoles above and below it.

For a semi directional pattern with 9 db gain mount the dipoles in line on one side of the mast. Gain at 100° either side of center will be 5 db. Gain directly in back of the antenna will be 1.5 db.

TUNING: The Reddi Match units are preset for FM operation. In most installations no tuning will be required. If you do find it necessary to tune follow the procedure outlined below for each dipole.

(1.) Insert a good quality standing wave bridge in the 52 ohm line between the signal source and the dipole.

(2.) Adjust the bridge for maximum forward power. Check the standing wave ratio with the bridge in the reverse position. If the VSWR is high loosen the tuning strap and adjust it slightly in either direction. Move away from the antenna and check the reading. If the SWR has increased move the strap back to its original position and adjust in the opposite direction. If the SWR dropped repeat the adjustment procedure until there is little or no reflected power indicated on the bridge.

After tuning or checking the dipoles connect the coaxial phasing harness as illustrated in figure 2. Connect your 52 ohm feed cable to the center connector, figure 2. Dress the cables along the booms and down the mast, using tape to hold it in position. Re-check and tighten all fasteners and connections.

2

RADIAL RING ASSEMBLY

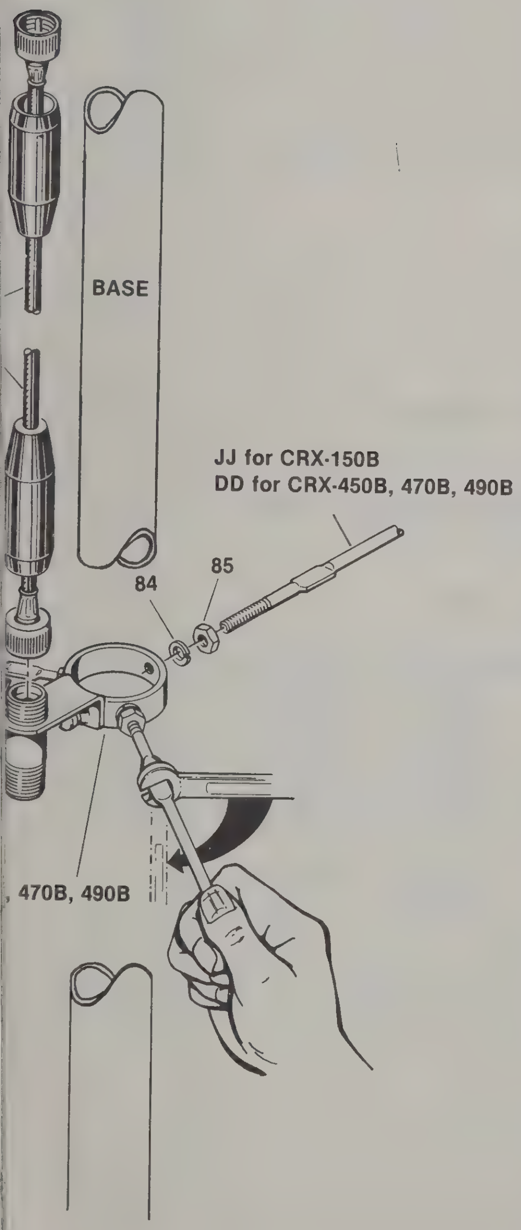


CHART 1A

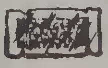
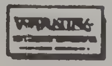
DIM	CRX-150B	CRX-450B	CRX-470B	CRX-490B
A		16-1/2"	15-7/8"	15-1/4"
C		2-7/8"	2-7/8"	2-7/8"
D	48-1/4"	18-1/2"	18-1/2"	17-1/2"

CHART 1B

FREQUENCY (MHz)	DIM A	DIM B	DIM C
146	55"	50-1/4"	9"
148	54-1/4"	49-1/2"	8-7/8"
150	53-1/2"	48-3/4"	8-3/4"
152	52-3/4"	48"	8-5/8"
154	52"	47-1/4"	8-5/8"
156	51-1/4"	46-1/2"	8-1/2"
158	50-1/2"	46"	8-3/8"
160	50"	45-1/2"	8-1/4"
162	49-1/4"	45"	8-1/4"
164	48-3/4"	44-1/2"	8-1/8"
166	48"	44"	8"
168	47-1/2"	43-1/2"	7-7/8"
170	47"	43"	7-7/8"
172	46-1/2"	42"	7-3/4"
174	46"	41-1/2"	7-5/8"

MODEL	FREQUENCY RANGE MHz	CENTER FREQUENCY MHz
CRX-150B	146-174	160
CRX-450B	450-470	460
CRX-470B	470-490	480
CRX-490B	490-512	501

PARTS PACKAGE CRX-450B, CRX-470B and CRX-490B

PART #	KEY	DETAIL	DESC.	SIZE	QTY.
010085	85		HEX NUT	1/4" – 20 (0.64cm)	3
010084	84		SPLITLOCK WASHER	1/4" (0.64cm)	3
050115	115		VINYL BOOT		1
240116	116		SILICONE	—	3
290326	500		WARNING LABEL		1

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SPECIFICATIONS

Gain	5.5dB
Nominal Impedance	50
VSWR	1.1 or Less at Resonance
Power Handling	250 watts
Lightning Protection	dc ground
Vertical Element	.058 wall 6063-T832 aluminum tubing
Hardware	stainless steel
Wind Survival: mph (km/h)	90 (145)
Termination	UHF, accepts PL-259

	CRX-150B	CRX-450B	CRX-470B	CRX-490B
Wind Surface Area: ft.^{2}	1.4	.27	.27	.27
(m^2)	(.42)	(.08)	(.03)	(.03)
Weight: lbs. (kg.)	7 (3.18)	2.6 (1.17)	2.6 (1.17)	2.6 (1.17)
Maximum Height: in.	161.5	54	53	52
(cm.)	(410.21)	(137)	(134)	(132)
Maximum Mast O.D.: in. (cm.)	1.25 (3.2)	7/8 (2.2)	7/8 (2.2)	7/8 (2.2)

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48 Perimeter Road, P.O. Box 4680
Manchester, NH 03108

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ASSEMBLY AND INSTALLATION INSTRUCTIONS

CRX-150B
CRX-450B
CRX-470B
CRX-490B

RINGO RANGER II ANTENNAS

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CRX-150B684

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SPECIFICATIONS

Gain	5.5dB
Nominal Impedance	50
VSWR	1.1 or Less at Resonance
Power Handling	250 watts
Lightning Protection	dc ground
Vertical Element	.058 wall 6063-T832 aluminum tubing
Hardware	stainless steel
Wind Survival: mph (km/h)	90 (145)
Termination	UHF, accepts PL-259

	CRX-150B	**CRX-450B**	**CRX-470B**	**CRX-490B**
Wind Surface Area: ft.^{2}	1.4	.27	.27	.27
(m^2)	(.42)	(.08)	(.03)	(.03)
Weight: lbs. (kg.)	7 (3.18)	2.6 (1.17)	2.6 (1.17)	2.6 (1.17)
Maximum Height: in.	161.5	54	53	52
(cm.)	(410.21)	(137)	(134)	(132)
Maximum Mast O.D.: in. (cm.)	1.25 (3.2)	7/8 (2.2)	7/8 (2.2)	7/8 (2.2)

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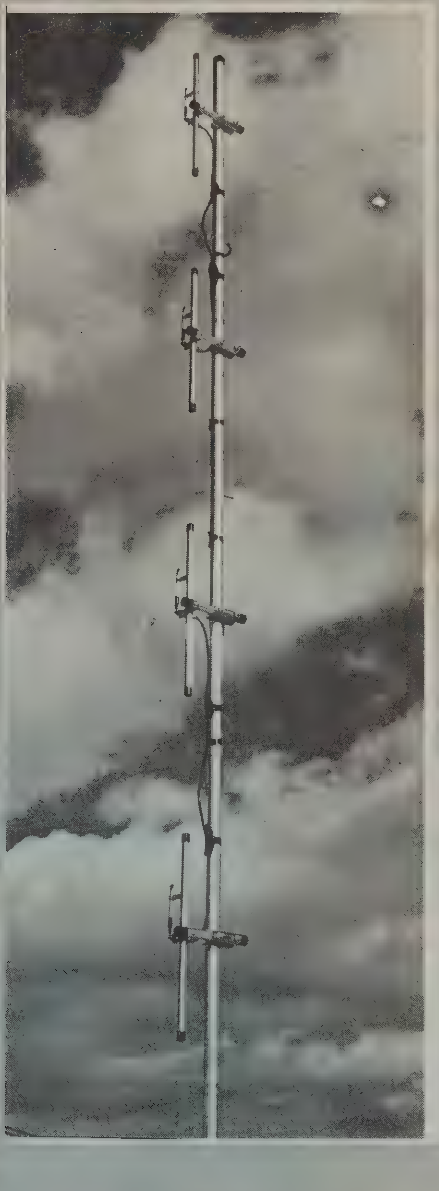
ASSEMBLY INSTRUCTIONS



4 POLE

OMNI GAIN ANTENNA

AFM 4D
AFM 24D AFM 44D

PARTS LIST

DESCRIPTION	QUANTITY
Dipole assembly with Reddi Match	4
Mounting booms 7/8" aluminum tubing	4
Coax stacking harness	1

PARTS PACKAGE

PART #	DESCRIPTION	QUANTITY
5	5/16" Lock washers	8
6	5/16" Hex nuts	8
31	2" x 4" U-bolt	4
32	3 1/2" Formed aluminum u-bolt bracket	4
33	3 1/2" Aluminum u-bolt backing plate	4
12	3/4" Plastic caps	8
61	7/8" Plastic caps	8

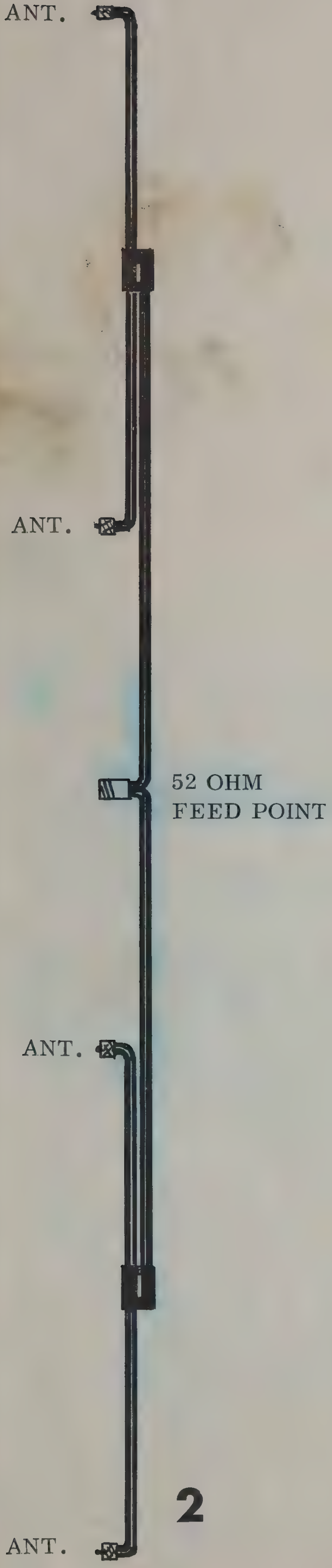
INSTALLATION SUGGESTIONS

Your Cush Craft Four Pole is designed and manufactured to give top performance and trouble free service. The antenna will perform as specified if the instructions and suggestions are followed and if care is used in assembly and installation.

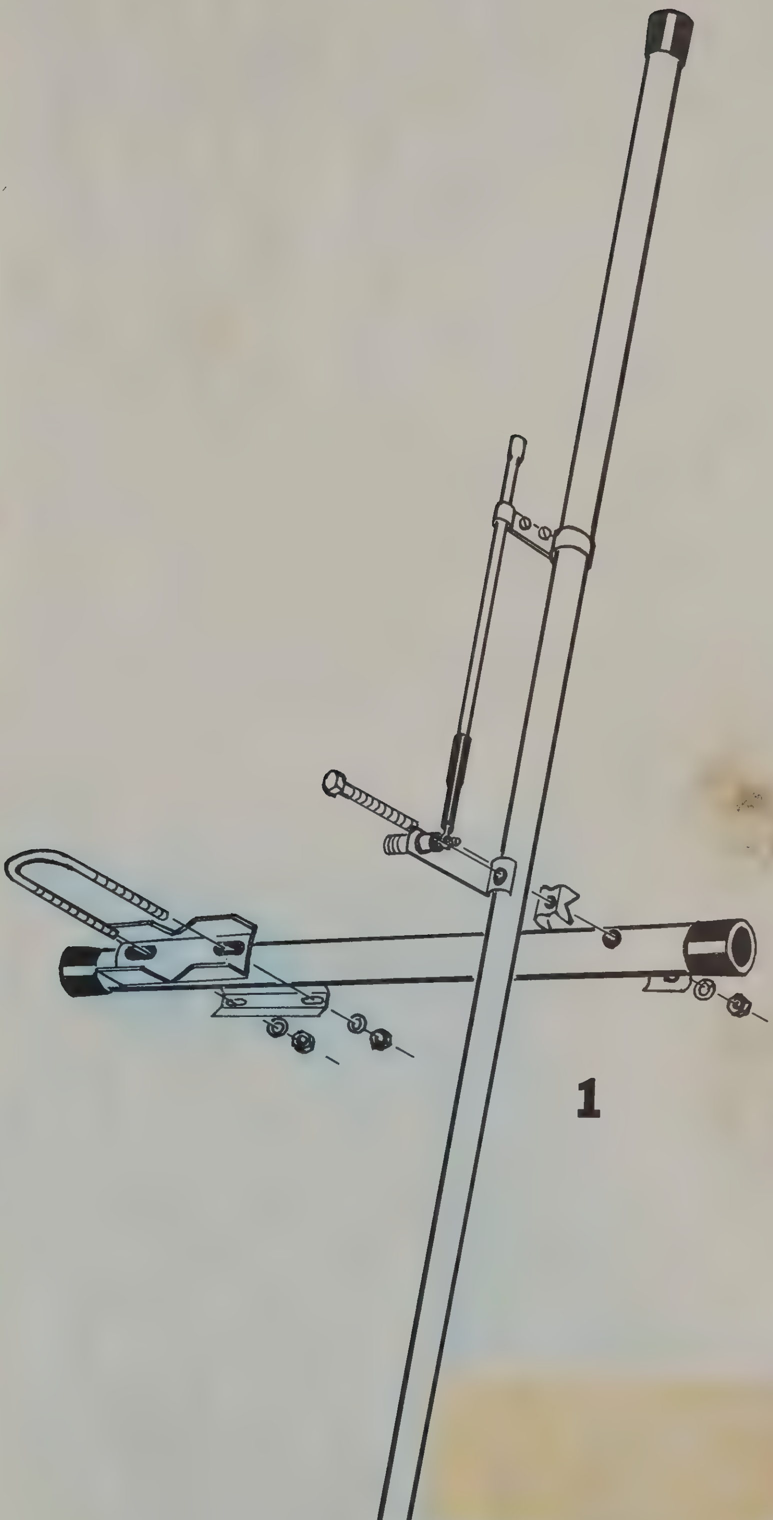
MASTING: The mast mount brackets will take up to a 2" O.D. mast. For protected installations where severe wind and weather will not be encountered a 1 1/4" O.D. steel television type tubing will be satisfactory. At remote exposed locations where wind and ice loading will be encountered a heavy wall 2" O.D. steel or aluminum mast should be used. The AFM-4D requires 24' of masting, the AFM-24D - 15' and the AFM-44D - 7' of mast.

LOCATION: Separation between the four pole and another transmit or receive antenna at the same repeater site should be 20 to 30 feet minimum. Two four poles may be used or the antenna may be used in conjunction with the AR-2, the AR-220 or the AR-450 Ringo.

The AFM-24D - 220-225 MHz and the AFM-44D - 435-450 MHz. All four pole models will handle 1000 watts of power.



2



1

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AMATEUR ● CITIZENS BAND ● COMMERCIAL COMMUNICATION & TELEVISION ANTENNAS ● BLITZ BUG COAXIAL LIGHTNING ARRESTER

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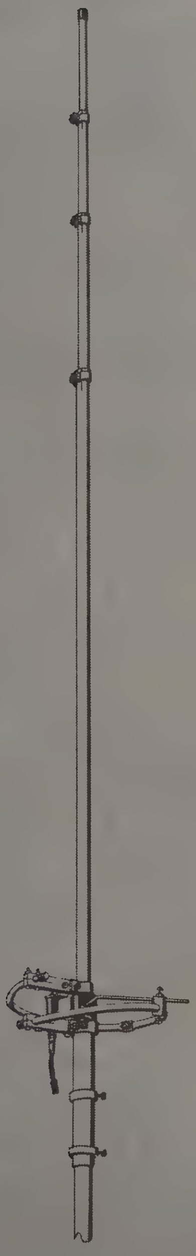
ASSEMLBY INSTRUCTIONS



HEAVY DUTY PROLINE RINGOS

BR-2, BR-3, BR-4

SPECIFICATIONS

Gain	---	3db
Nominal Impedance	---	50 Ohms
VSWR	---	1.5-1 maximum
Power Handling	---	500 Watts
Lightning Protection	---	DC ground
Radiating Element	--	.116 + .058 wall 6063-T832 Aluminum tubing
Hardware		stainless steel
Wind Surface area	---	1.73 ft²
Wind Survival	---	115 MPH
Weight	---	8 lbs.
Maximum Height	---	BR-2 18'6" BR-3 14'0" BR-4 10'6"
Termination	---	UHF, accepts PL-259
Shipping Dimensions	---	62" x 13" x 2 1/2" Parcel Service

PARTS LIST

DESCRIPTION	QUANTITY		
	BR-2	BR-3	BR-4
Base assembly with insulators and coax fittings	1	1	1
Ring section	2	2	2
Tuning rod 3/16" aluminum, formed one end taped to base	1	1	1
1" x 48" .058 wall aluminum tubing, slotted and marked	1	1	1
7/8" x 48" .058 wall aluminum tubing	-	-	1
7/8" x 48" .058 wall aluminum tubing, slotted and marked	1	1	-
3/4" x 48" .058 wall aluminum tubing	-	1	-
3/4" x 48" .058 wall aluminum tubing, slotted and marked	1	-	-
5/8" x 48" .049 wall aluminum tubing	1	-	-

PARTS PACKAGE

PART NO.	DESCRIPTION	QUANTITY		
		BR-2	BR-3	BR-4
10	#8 Internal tooth lock washer	5	5	5
11	8-32 Stainless steel hex nut	5	5	5
53	1/2" Plastic cap	2	2	2
90	Mast mounting ring clamp	2	2	2
81	1/4-20 x 3/4"Stainless steel RH machine screw	1	1	1
84	1/4" Stainless steel lock washer	1	1	1
85	1/4"-20 Stainless steel hex nut	1	1	1
91	Tuning rod block	1	1	1
92	Epoxysealer package with 3/8 cap	1	1	1

INSTALLATION SUGGESTIONS

Your Cushcraft heavy duty Ringo is designed and manufactured to give top performance and trouble free service. It will perform as specified, if the assembly and installation suggestions are followed.

MASTING: The antenna will take up to a 1-7/8" O.D. mast. A good solid support mast should be used for all antenna installations.

LOCATION of the antenna is very important. Surrounding objects such as trees, power lines, other antennas, etc. will seriously reduce efficiency. To minimize the effects of surrounding objects, mount the antenna as high and in the clear as possible. If metal guy wires are used, they should be broken with strain insulators. WARNING: THIS ANTENNA IS AN ELECTRICAL CONDUCTOR, CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION — REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. CONSULT THE NATIONAL ELECTRICAL CODE FOR FURTHER DETAILS.

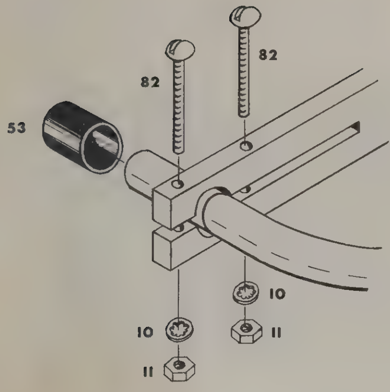


FIGURE 1

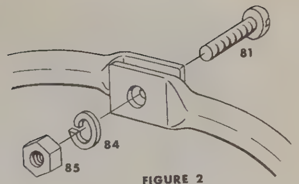


FIGURE 2

CUSH CRAFT BR-SERIES
BASE-ASSEMBLY DIAGRAM

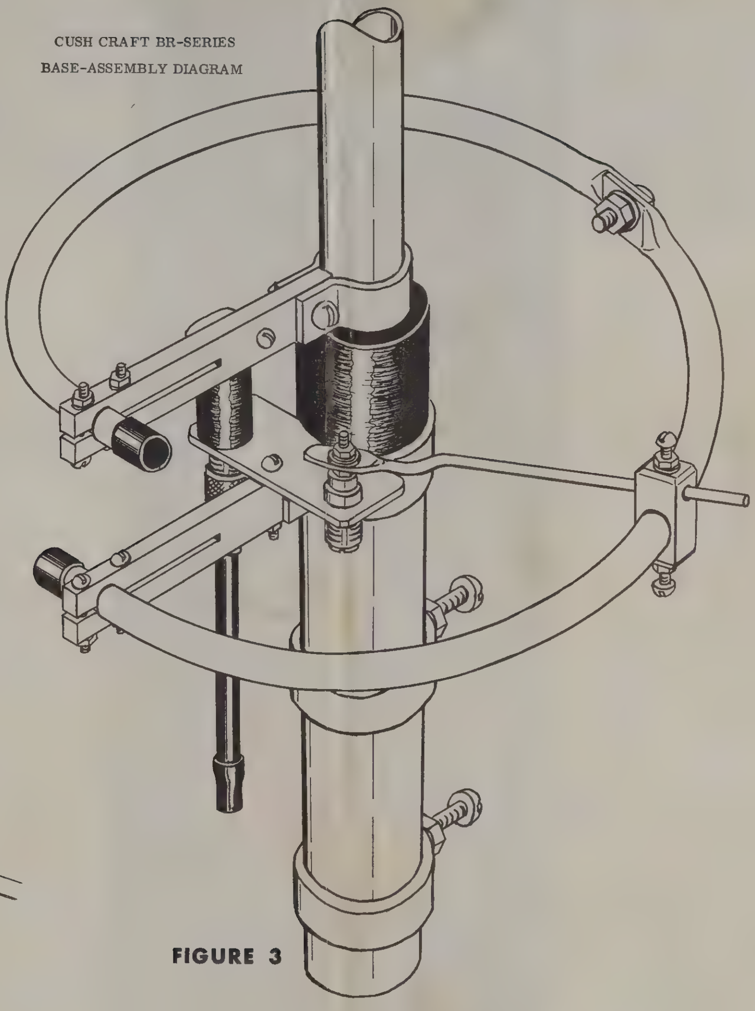


FIGURE 3

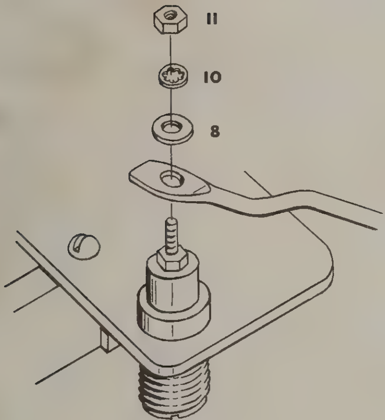


FIGURE 4

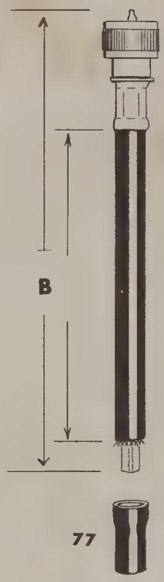
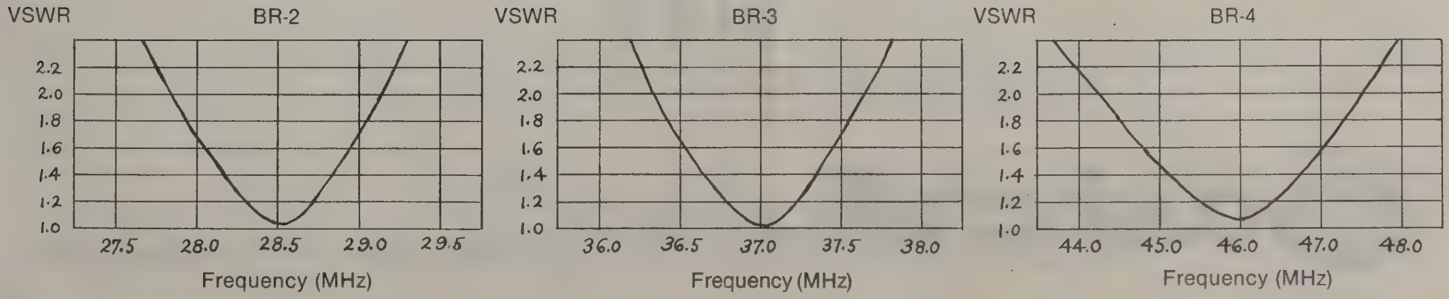


FIGURE 5

TYPICAL VSWR GRAPHS.



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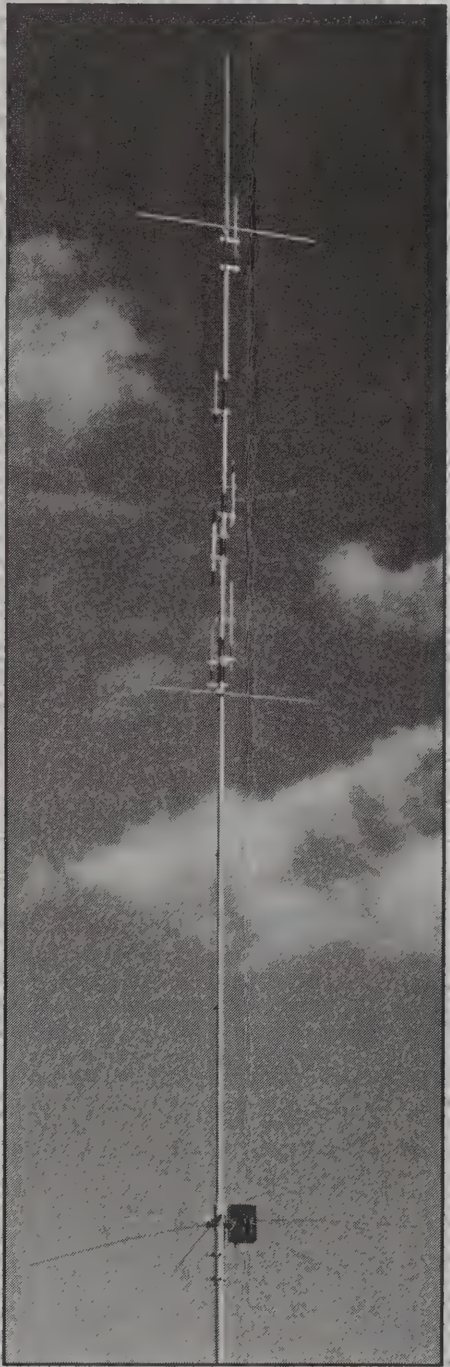
ASSEMBLY AND INSTALLATION



R7

10, 12, 15, 17, 20, 30, 40 METERS

cushcraft CORPORATION

951420 (4/91)

WARNING

THIS ANTENNA IS AN ELECTRICAL CONDUCTOR. CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION, REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. FOLLOW THE GUIDELINES FOR ANTENNA INSTALLATIONS RECOMMENDED BY THE U.S. CONSUMER PRODUCT SAFETY COMMISSION AND LISTED IN THE ENCLOSED PAMPHLET.

Your Cushcraft R7 vertical antenna is designed and manufactured to give trouble free service. This antenna will perform as specified if the instructions and suggestions in this manual are followed and care is used in the assembly and installation. When checking the components received in your antenna package use the parts listed beside each diagram. There is a master parts list on page 2. If you are unable to locate any tube or component, check the inside of all tubing. IMPORTANT: Save the weight label from the outside of the carton. Each antenna is weighed at the factory to verify the parts count. If you claim a missing part, you will be asked for the weight verification label.

PLANNING

Plan your installation carefully. If you use volunteer helpers be sure that they are qualified to assist you. Make certain that everyone involved understands that you are the boss and that they must follow your instructions. If you have any doubts at all, employ a professional antenna installation company to install your antenna.

LOCATION

Although the R7 will operate in almost any location, it will perform best if it is mounted vertically and located in the clear away from surrounding objects such as buildings, trees, power lines, towers, guy wires, antennas and metallic objects. The R7 should not be attached to a ground radial system. Failure to heed these points will possibly degrade performance, detune the antenna and increase VSWR.

EXTREME CARE MUST BE USED FOR YOUR SAFETY. YOU MUST INSURE THAT WHILE THE R7 IS IN OPERATION NEITHER PEOPLE OR PETS CAN COME IN CONTACT WITH ANY PORTION OF YOUR ANTENNA INCLUDING THE COUNTERPOISE RODS. DEADLY VOLTAGES AND CURRENTS MAY EXIST. ALSO, SINCE THE EFFECTS OF EXPOSURE TO RF ARE NOT FULLY UNDERSTOOD, LONG TERM EXPOSURE TO INTENSE RF FIELDS IS NOT RECOMMENDED. THERE ARE SEVEN WARNING STICKERS WHICH MUST BE ATTACHED TO THE ENDS OF THE COUNTERPOISE RODS AS SHOWN IN FIGURE 3.

MOUNTING

Your mast should be rigid and pointing straight up. Always use a mast at least 1.5 inches (3.8 cm) but not larger than 1.75 inches (4.5 cm) in diameter. If you guy the mast, use non-conducting guy wires.

SYSTEM GROUNDING

Direct grounding of the antenna mast is very important. This serves as protection from lightning strikes and static buildup, and from high voltages which may be present in the equipment attached to the antenna. A good electrical connection should be made to one or more ground rods directly at the base of the antenna or mast using a least #10 AWG ground wire and non-corrosive hardware. For details and safety standards, consult the National Electrical Code. You should also use a coaxial lightning arrestor. Cushcraft offers several different models, such as the LAC-1, LAC-2 or the LAC-4 series.

ASSEMBLY

Assemble your R7 by following steps 1 through 6. After assembling the antenna, verify all dimensions in figure 5 for accuracy. Then return to the adjustment section below for final tuning.

ADJUSTMENT

The dimensions in figure 5 normally allow proper operation on all the bands. However, some variations may occur from one location to another. Adjustments must be made from the bottom of the antenna to the top. Adjusting the antenna from top to bottom will not work. This is because the settings at the top are severely affected by the adjustments at the bottom. The bottom section A of the antenna covers 10 meters, the next sections cover 12, 15, 17, 20, and 30 meters while the top section F covers 40 meters.

We suggest measuring the VSWR of your antenna by using the SWR meter in your tranceiver. If your tranceiver does not have one, use a good quality VSWR bridge for this application. We will begin with 10 meters since this is at the bottom of the antenna. Set your tranceiver at your favorite frequency on 10 meters. Key the rig and check your VSWR. The R7 is extremely broadbanded on 10 meters and this section seldom needs adjustment. If the VSWR is low enough (below 1.5:1) then move on to the 15 meter section B (12 meters is not adjustable). If the 10 meter VSWR is not low enough, adjust the antenna as follows: Check several frequencies on 10 meters to find the frequency of lowest VSWR. If the frequency of lowest VSWR is above your favorite frequency, lengthen dimension A figure 5 by 1 inch (2.5 cm). This should lower the frequency of lowest VSWR by 50 to 100 KHz. If the frequency of lowest VSWR is below your desired frequency, shorten dimension A figure 5 by 1 inch (2.5 cm). Check your desired 10 meter operating frequency again to see if the VSWR is less than 1.5:1. Repeat this procedure until the VSWR at your desired frequency is low enough.

Continue this procedure by selecting your desired frequency on 15 meters and checking the VSWR there. Dimension B figure 5 should be used to adjust the VSWR on 15 meters. Remember to shorten this dimension to raise the frequency or lengthen it to lower the frequency.

The balance of the antenna should be adjusted in a like manner. The dimensions and the bands that they effect are shown in figure 5. On 10 through 20 meters 1 inch (2.5 cm) of change in length will change the operating frequency by 50 to 100 KHz. On 30 and 40 meters the change will be 15 to 25 KHz per inch (5 to 10 KHz/cm). When the antenna is completely adjusted, check all fasteners to be sure they are tight. Improving VSWR's that are less than 2:1 will not noticeably improve station performance.

INSTALLATION

Following the guidelines in the location and adjustment sections above, place the antenna on its mast in its final operating location. If you plan to install the antenna in a salty or corrosive environment, you may want to consider coating it with a clear marine varnish or equivalent *after final assembly and adjustment has been completed.* Now connect your transceiver. If you have any difficulties, reread the information above and the helpful hints below.

HELPFUL HINTS

- Try to locate your R7 as far away from TV antennas and their feedlines as possible. This will help to avoid overloading your television with RF.

- The dimensions recommended in figure 5 are based on mounting the R7 approximately 5 feet (1.5 meters) above the ground and 25 feet (7.5 meters) from surrounding objects. Antennas installed with less clearance may require additional adjustments.

- If you check the resistance across the coax connector on your R7 you will find a DC short. This is normal. It does not mean that the RF path is short circuited. It is approximately 50 Ohms at your operating frequencies.

- High VSWR is sometimes caused by poor contact between the matching network and the counterpoise rods. Make sure that corrosion has not formed on the jumper strap terminals. Check to insure the hardware is tight.

- Make sure that the counterpoise brackets are 1 inch (2.54 cm) above the antenna base and 1-3/4 inch (4.45 cm) below the radiator as shown on figure 1. The counterpoise is a frequency sensitive system. Changing its length will degrade the R7's performance.

- If your R7 is very close to your shack you may experience RF on the feedline. Try lengthening your feedline several feet, placing an RF ferrite bead on the coax, winding the feedline on a toroid or winding the coax in a 10 turn coil 8 inches (20 cm) in diameter.

- Weather sealing the matching network is not necessary. We have provided a large hole near the coax connector to allow air to circulate through the box and to keep it dry. Keep this hole clear to avoid difficulties caused by humidity and condensation.

- Long periods (30 seconds or longer) of key down operation, such as RTTY, at high power (over 1000 Watts) may damage your R7.

MASTER PARTS LIST

KEY	P/N	DESCRIPTION	QTY
AA		Base Section Assembly, 1-3/8" x 48" (2.8 x 121.9 cm)	1
AB		1-1/4" x 48" (3.2 x 121.9 cm) aluminum tube slotted one end	1
AC		1-1/8" x 48" (2.9 x 121.9 cm) aluminum tube slotted one end	1
AD		1-1/8" x 9" (2.9 x 22.9 cm) aluminum tube slotted both ends	1
AE		1" x 14" (2.5 x 35.6 cm) aluminum tube slotted both ends	1
AF		1" x 18" (2.5 x 45.7 cm) aluminum tube slotted both ends	1
AG		1/2" x 24" (1.3 x 61 cm) aluminum tube slotted one end	1
AH		3/8" x 24" (.9 x 61 cm) aluminum tube	1
TV1		10/12 meter trap assembly 34-5/8" (88 cm)	1
TV2		15 meter trap assembly 15" (38.1 cm)	1
TV3		17 meter trap assembly 15-3/4" (40 cm)	1
TV4		20 meter trap assembly 21" (53.3 cm)	1
TV5		30 meter trap assembly 22-1/4" (56.5 cm)	1
XHR		3/16" x 36" (.4 x 91.4 cm) aluminum rod with #18 hole drilled mid point	2
MN7		Impedance Matching Assembly	1
11	010011	8-32 stainless steel hex nut	28
26	190026	7/8" (2.22 cm) formed aluminum bracket with #8 hole	4
28	190028	Aluminum half washer	4
41	011941	#8 split lock washer	28
77	050077	3/8" (.95 cm) black plastic cap	1
79	010079	8-32 x 1/2" (1.27 cm) stainless steel machine screw	21
83	010083	1/4-20 x 1-1/4" (3.2 cm) stainless steel machine screw	4
84	010084	1/4" (.63 cm) stainless steel split lock washer	4
85	010085	1/4-20 stainless steel hex nut	4
96	202296	7/8" x 3-3/4" (2.22 x 9.53 cm) radial clamp	6
110	203110	Mast mounting ring	2
115	050115	Vinyl connector boot	1
116	240116	Silicone grease packet	1
119	203119	7/8" x 5-3/8" (2.22 x 13.7 cm) radial clamp	1
220	010220	10-24 stainless steel hex nut	1
231	010231	8-32 x 1-3/4" (4.44 cm) stainless steel machine screw	4
233	010233	#10 stainless steel split lock washer	1
407	030407	7/32" (.5 cm) stainless steel worm clamp	1
409	030409	7/8" (2.22 cm) stainless steel worm clamp	1
410	030410	1" (2.54 cm) stainless steel worm clamp	5
411	030411	1-1/4" (3.17 cm) stainless steel worm clamp	3
412	030412	1-1/2" (3.81 cm) stainless steel worm clamp	2
326	290326	Warning label	7
429	902428	Jumper Strap	2
832	902832	0.100" x 49" (.25 x 124 cm) stainless steel rod with ball tip one end	7

#1 - ASSEMBLE COUNTERPOISE BRACKETS

Assemble two brackets (96) leaving the nuts (11) loose (figure 1). Make three sets like this. Attach two sets together around the base insulator making the lower bracket assembly. Locate the lower bracket assembly 1 inch (2.54 cm) above the base tube (figure 2). Attach the two remaining brackets (96) you previously assembled around the base insulator using bracket (119) as shown in figure 2. Locate this upper bracket assembly directly above and touching the lower bracket assembly.

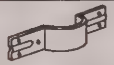
KEY	PN		DESC.	SIZE	QTY
11	010011		HEX NUT	8-32	21
41	011941		LOCK WASHER	#8	21
79	010079		MACHINE SCREW	8-32 x 1/2" (1.3 cm)	21
96	202296		ROD BRACKET	3-3/4" x 7/8" (9.53 x 2.22 cm)	6
119	203119		ROD BRACKET	5-3/8" x 7/8" (13.7 x 2.22 cm)	1

FIGURE 1

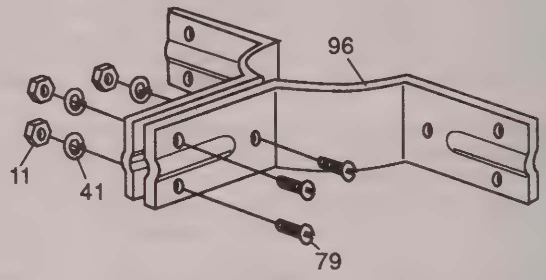
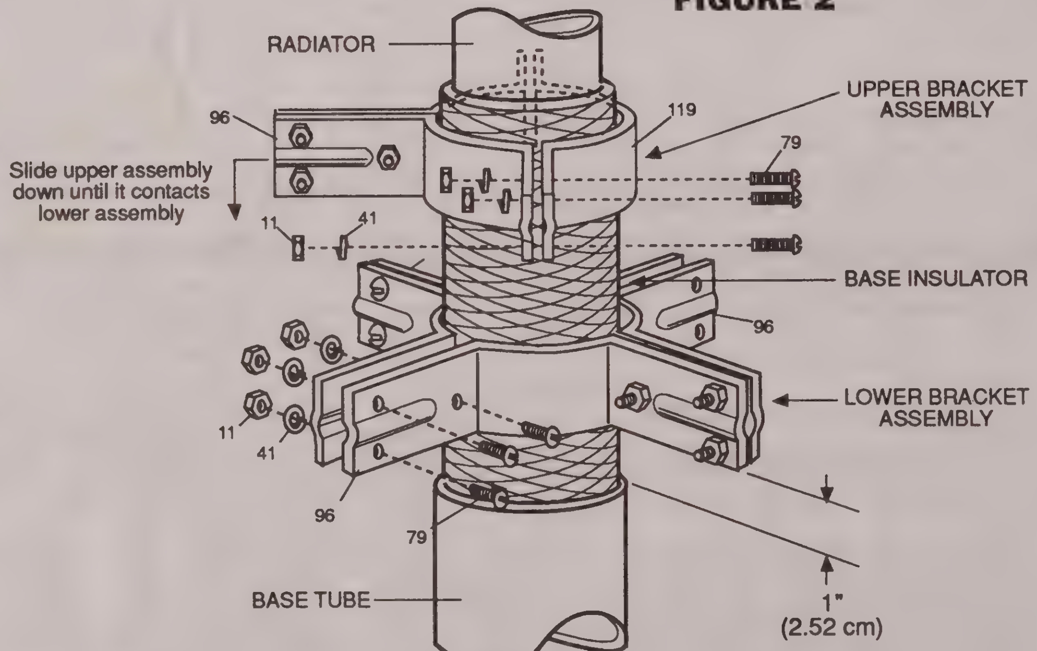


FIGURE 2



#2 - ASSEMBLE BASE SECTION

Attach the Impedance Matching Assembly (MN7) to the radiator bracket (figure 3). To do this you may have to rotate the counterpoise bracket assemblies (figure 2) slightly if they are in the way. Note that the half round bracket (119) in the upper assembly must be directly behind the MN7. Holding the box with the pre-attached bracket on the bottom and next to the base tube, lift the box so that the mounting bolts on the top of the box go through the holes in the upper mounting bracket. Attach the bottom of the box to the protruding screw and secure with washer (233) and nut (220). Attach a jumper strap (428) between MN7 and the lower brackets and another jumper strap between the upper and lower brackets as shown. Next, assemble and position the mast mount rings (110). Be sure that the locking screws in the mast mount ring go through the pre-drilled holes in the R7 base (figure 4). The counterpoise rods will be attached later (step 5).

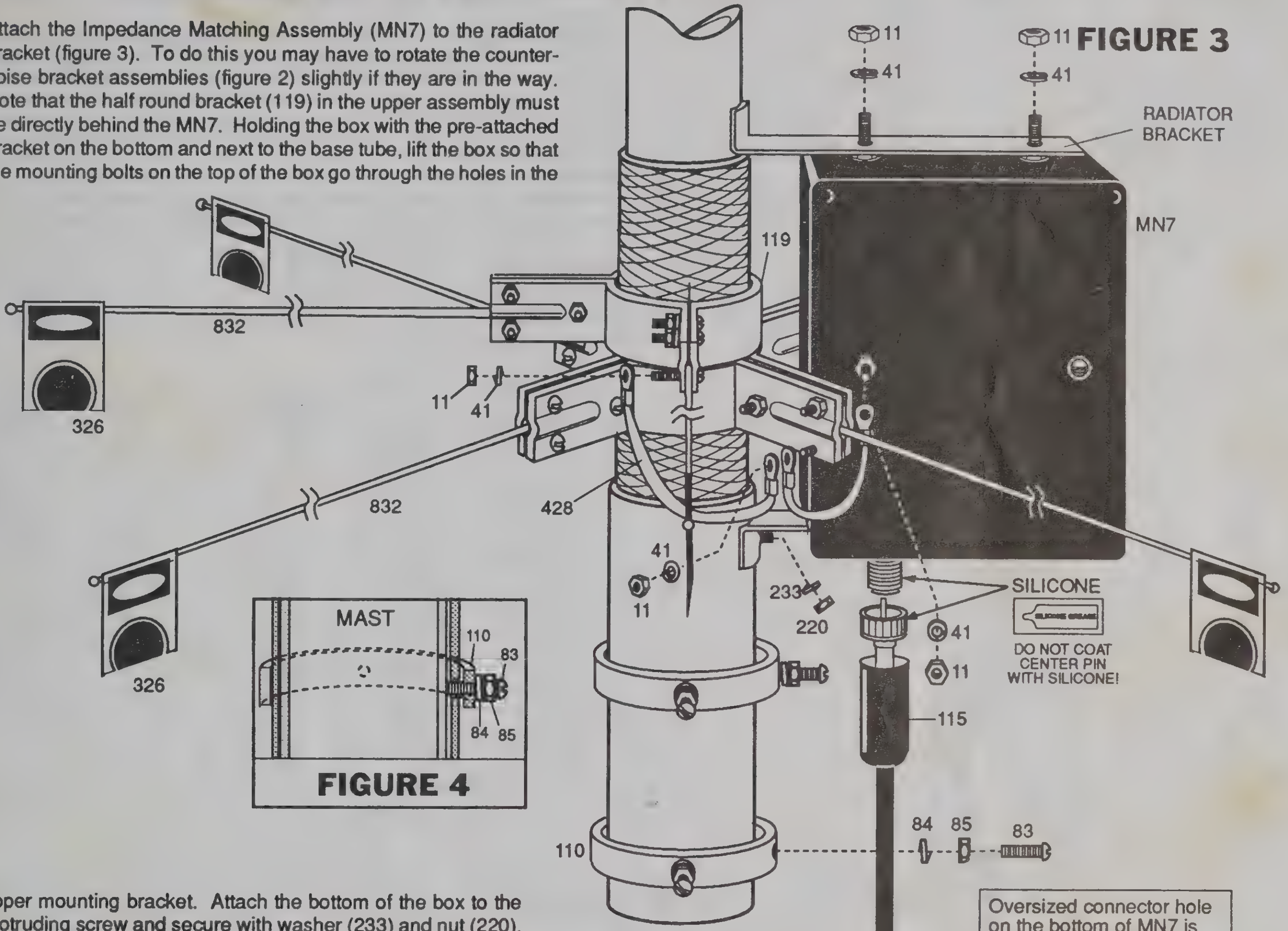


FIGURE 3

FIGURE 4

Oversized connector hole on the bottom of MN7 is for drainage.
DO NOT FILL THIS HOLE!

KEY	PN		DESC.	SIZE	QTY
11	010011		HEX NUT	8-32	3
41	011941		LOCK WASHER	#8	3
83	010083		MACHINE SCREW	1/4-20 x 1-1/4" (3.2 cm)	4
84	010084		LOCK WASHER	1/4" (.6 cm)	4
85	010085		HEX NUT	1/4-20	4
110	203110		MAST MT. RING		2
115	050115		CONNECTOR BOOT		1
116	240116		SILICONE PACKET		1
220	010220		HEX NUT	10-24	1
233	010233		LOCK WASHER	#10	1
326	290326		WARNING LABEL		7
428	902428		JUMPER STRAP		2
832	902832		COUNTERPOISE ROD	49" (124 cm)	7
MN7			IMPEDANCE MATCHING ASSEMBLY		1

TABLE 1
40 Meter Setting For Dimension F

CW	CENTER	PHONE
35-1/2" (90.2 cm)	29" (73.7 cm)	23-1/2" (59.7 cm)

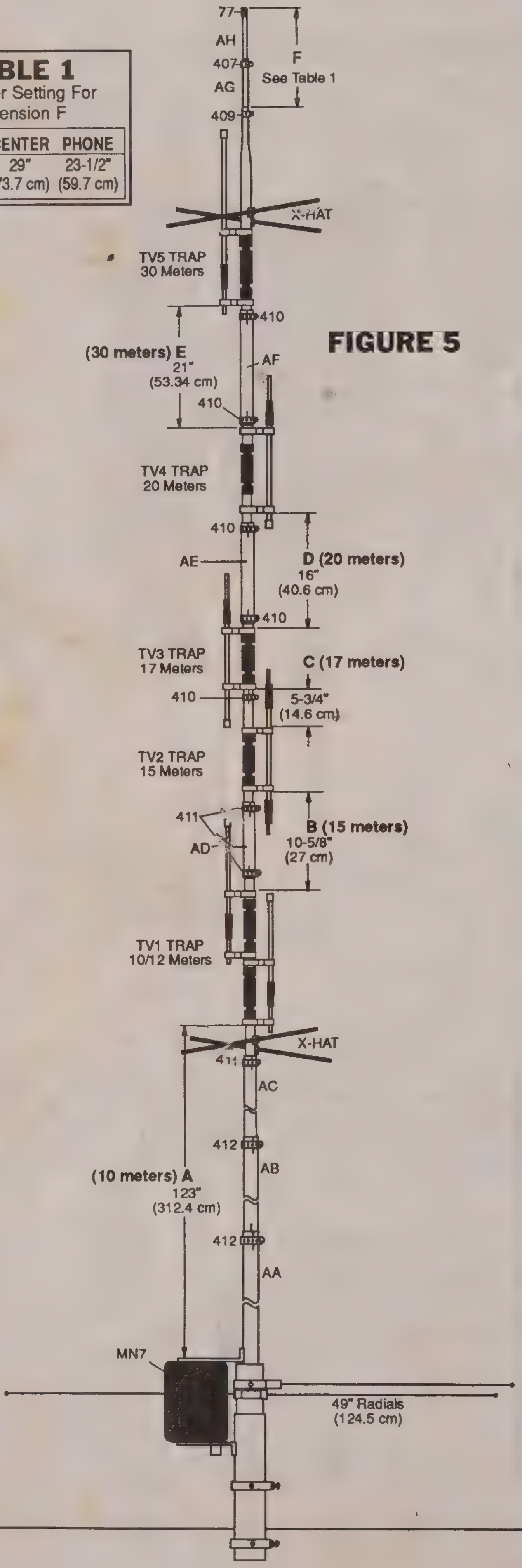
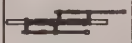


FIGURE 5

#3 - ASSEMBLE VERTICAL

When the base assembly is completed, place worm clamp (412) over the top of the radiator tube (AA). Insert the tube AB 6 inches (15 cm) into AA and tighten the clamp. Continue the same procedure with tube AC. Place worm clamp (411) over the top of AC, insert the TV1 trap, set dimension A and tighten the worm clamp. Note that the arrows on the traps must point up when assembled. The X-hats will be attached later during step 4. Attach the TV2 trap with the tube AD centered between the traps and set dimension B. The external trap capacitors should alternate from one side of the antenna to the other as you assemble the antenna. Assemble traps TV3, TV4 and TV5 with tubes, worm clamps and dimensions shown on figure 5. Insert the tube AG 3 inches (7.6 cm) into the top of the TV5 trap and tighten the clamp (409). Insert tube AH and set dimension F using the dimensions shown in table 1. Tighten clamp (407). Place a cap (77) on the top of tube AH.

KEY	PN		DESC.	SIZE	QTY
77	050077		PLASTIC CAP	3/8" (.95 cm)	1
407	030407		WORM CLAMP	7/32" (.5 cm)	1
409	030409		WORM CLAMP	7/8" (2.2 cm)	1
410	030410		WORM CLAMP	1" (2.5 cm)	5
411	030411		WORM CLAMP	1-1/4" (3.2 cm)	3
412	030412		WORM CLAMP	1-1/2" (3.8 cm)	2
AA			BASE ASSEMBLY	48" (121.9 cm)	1
AB			ALUMINUM TUBE	1-1/4" x 48" (3.2 X 121.9 cm)	1
AC			ALUMINUM TUBE	1-1/8" x 48" (2.9 x 121.9 cm)	1
AD			ALUMINUM TUBE	1-1/8" x 9" (2.9 X 22.9 cm)	1
AE			ALUMINUM TUBE	1" x 14" (2.5 x 35.6 cm)	1
AF			ALUMINUM TUBE	1" x 18" (2.5 x 45.7 cm)	1
AG			ALUMINUM TUBE	1/2" x 24" (1.3 x 61 cm)	1
AH			ALUMINUM TUBE	3/8" x 24" (.9 x 61 cm)	1
TV1			10/12 METER TRAP	34-5/8" (88 cm)	1
TV2			15 METER TRAP	15" (38.1 cm)	1
TV3			17 METER TRAP	15-3/4" (40 cm)	1
TV4			20 METER TRAP	21" (53.3 cm)	1
TV5			30 METER TRAP	22-1/4" (56.5 cm)	1

#4 - ASSEMBLE X-HATS

Assemble and attach the X-hats to the bottom of the TV1 and the top of the TV5 traps (using the pre-drilled holes) as shown in figure 6.

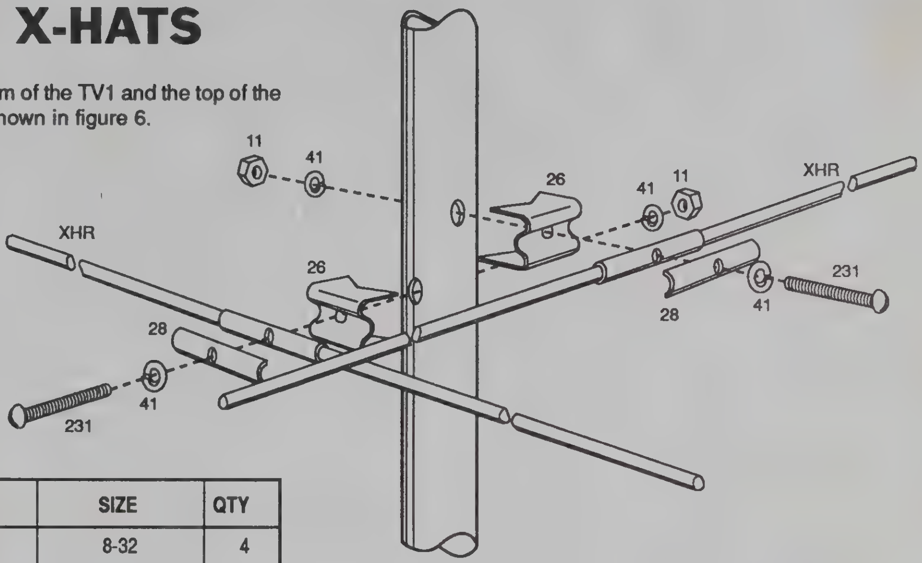


FIGURE 6

KEY	PN		DESC.	SIZE	QTY
11	010011		HEX NUT	8-32	4
26	190026		FORMED BRACKET	7/8" (2.2 cm)	4
28	190028		ALUM. HALF WASHER		4
41	011941		LOCK WASHER	#8	8
231	010231		MACHINE SCREW	8-32x1-3/4" (4.4 cm)	4
XHR			X-HAT ROD	36" (91.4 cm)	4

#5 - ATTACH COUNTERPOISE RODS

Insert four of the 49 inch (124 cm) counterpoise rods into the slots on the end of the lower bracket assembly on the base insulator. Adjust the brackets so that the rods are equally spaced about the matching network. Firmly tighten the machine screws and nuts while observing the location of the brackets on the base insulator (figure 2). Insert the remaining three counterpoise rods into the ends of the upper bracket assembly. Tighten the machine screws. Attach the warning labels (326) to the ends of the counterpoise rods as shown on figure 3. *IT IS VERY IMPORTANT TO USE THE WARNING LABELS BECAUSE DEADLY VOLTAGES CAN BE PRESENT ON THESE RODS.*

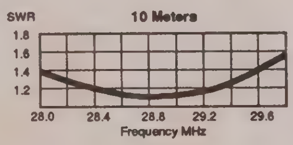
#6 - FEEDLINE

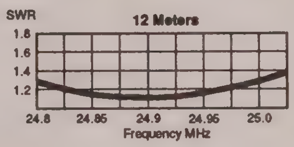
We have provided a weatherproof boot for the PL-259 connector on your feedline. Follow figure 3 to install it. Insert the antenna end of your coax through the small end of your connector boot. Many cables are very tight which results in an excellent weather seal. Attach a PL-259 to the end of your coax. Spread the silicone on the threads of the antenna connector. *SILICONE SHOULD NOT BE SPREAD ON THE CENTER PIN!* Apply the remaining silicone to the outside of the connector. Attach the connector to the matching network and slip the boot over the connector until it touches the bracket. Return to the adjustment section on page 1.

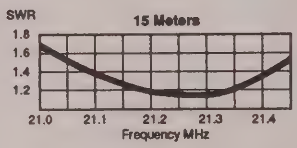
SPECIFICATIONS

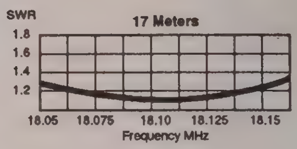
Frequency Bands (Meters)	10, 12, 15, 17, 20, 30, 40
Gain, dBi	3
Electrical Wavelength	
Each band	Half-wave
VSWR 1.2:1 Typical	
2:1 Bandwidth	10m (2.0 MHz), 12m (100 KHz), 15m (450 KHz), 17m (100 KHz), 20m (150 KHz) 30m (25 KHz), 40m (75 KHz)
Power Rating, Watts PEP	1800
Radiation Angle Typical	16°
Frequency Selection	Automatic
Horizontal Radiation Pattern Degrees	360°
Height, ft. (m)	22.5 (6.9)
Mast Size Range, in. (cm)	1.5-1.75 (3.8-4.4)
Wind Load, ft² (m²)	2.25 (.21)
Weight, lb. (kg)	12.3 (5.6)
49 inch (124 cm) Counterpoise Radials	7

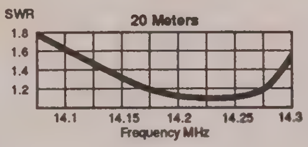
TYPICAL R7 VSWR DATA

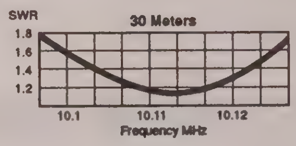


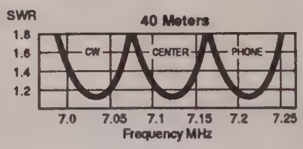












LIMITED WARRANTY

Cushcraft Corporation, P.O. Box 4680, Manchester, New Hampshire 03108, warrants to the original consumer purchaser for one year from date of purchase that each Cushcraft antenna is free of defects in material or workmanship. If, in the judgement of Cushcraft, any such antenna is defective, then Cushcraft Corporation will, at its option, repair or replace the antenna at its expense within thirty days of the date the antenna is returned (at purchasers expense) to Cushcraft or one of its authorized representatives. This warranty is in lieu of all other expressed warranties, any implied warranty is limited in duration to one year. Cushcraft Corporation shall not be liable for any incidental or consequential damages which may result from a defect. Some states do not allow limitations on how long an implied warranty lasts or exclusions or limitations of incidental or consequential damages, so the above limitation and exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. This warranty does not extend to any products which have been subject to misuse, neglect, accident or improper installation. Any repairs or alterations outside of the Cushcraft factory will nullify this warranty.

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ASSEMBLY INSTRUCTIONS

A449-6, A449-11, A220-11,
A147-4, A147-11, A147-22

A147-VPK, A14-VPK,
A220-VPK, A449-VPK

INSTALLATION SUGGESTIONS

Cush Craft VHF/UHF beam is designed and manufactured to give top performance and trouble free service. The antenna will perform as specified, if the instructions and suggestions are followed, and if care is used in assembly and installation.

MASTING: The mast mount brackets on the A147-11, A220-11, and A449-11 will take up to a 1-1/2" O.D. mast. A 1-1/4" O. D. television type tubing is satisfactory for any of the single beams. The A147-22 Power Pack may be mounted on a mast of up to 2" O.D. The A147-4 and A449-6 have extra-length booms for mast or tower side mounting.

MOUNTING: When mounting the beams on the same mast with other VHF/UHF antennas, they should be mounted at least 1/2 wave length (of the lower frequency) away from the other antennas. The beams may be mounted within 4' of 6 meter or HF antennas. Generally, it is best to mount these beams above lower frequency antennas.

ROTATOR: A good quality television antenna rotator will easily handle any of these antennas.

LOCATION: This is very important. Surrounding objects such as trees, power lines, other antennas, etc., will seriously reduce efficiency. To minimize the effects of surrounding objects, mount the antenna as high and in the clear as possible. If metal guy wires are used, they should be broken with strain insulators.

PARTS PACKAGE

PART NO.	DESCRIPTION	QUANTITY					
		A449-6	A449-11	A220-11	A147-4	A147-11	A147-22
1	2" U-bolts	-	-	-	-	-	2
2	1-5/8" U-bolts	-	-	-	-	-	2
3	1-1/2" U-bolts	-	-	-	-	4	8
4	1-1/2" U-bolt brackets	-	1	1	-	-	-
5	5/16" lock washers	2	-	-	2	-	8
6	5/16" hex nuts	2	-	-	2	-	8
12	3/4" plastic caps	-	-	-	2	-	-
14	1-1/2" U-bolt backing plate	-	1	1	-	-	-
15	1/4" flat steel washers	2	-	-	2	8	20
16	1/4" lock washers	-	2	2	-	8	16
17	1/4"-20 hex nuts	-	2	2	-	8	16
21	10-24 x 2" R H machine screws	2	2	10	3	10	20
22	10-24 hex nuts	2	2	10	3	10	20
25	7/8" formed alum. brackets	2	2	10	3	10	20
28	aluminum half washers	2	2	10	3	10	20
29	#10 internal-tooth lock washers	2	2	10	3	10	20
31	2"x4" U-bolts	1	-	--	1	--	--
32	3-1/2" U-bolt brackets	1	-	--	1	--	--
33	3-1/2" U-bolt backing plates	1	-	--	1	--	--
38	1" plastic caps	-	2	1	-	--	--
39	3/8" aluminum spacers	-	-	--	-	4	8
46	1-1/2" plastic caps	-	-	--	-	--	2
53	1/2" plastic caps	2	2	2	-	2	4
61	7/8" plastic caps	2	-	1	2	[illegible]	4
78	1-1/2"x3-1/2" U-bolts	-	1	1	-	[illegible]	--
G-10	1" telescope clamps	-	-	1	-	[illegible]	4

PARTS LIST

DESCRIPTION	QUANTITY A449-6	A449-11	A220-11	A147-4	A147-11	A147-22
7/8"x 44" boom				1		
7/8"x 50" boom sections					2	4
1"x 48" boom sections			1		1	2
7/8"x 35" boom	1					
1"x 53" boom		1				
7/8"x 56" boom sections			1			
1-1/2"x 41" boom sections						2
1-5/8"x 6" center splice						1
4"x 6" formed aluminum mast bracket					1	3
Coax harness assembly						1

ELEMENTS		LENGTH A449-6	A449-11	A220-11	A147-4	A147-11	A147-22
#1	Reflector	13-1/4"	13"	26-1/4"	39-3/4"	40"	40"
#2	Dipole	12-7/16"	12-3/8"	24-15/16"	38"	37-7/8"	37-7/8"
#3	Director	11-7/8"	11-3/4"	23-3/4"	36"	36"	36"
#4	Director	11-13/16"	11-9/16"	23-1/2"	35-3/4"	35-7/8"	35-7/8"
#5	Director	11-3/4"	11-1/2"	23-1/4"	-------	35-3/4"	35-3/4"
#6	Director	11-11/16"	11-7/16"	23"	-------	35-5/8"	35-5/8"
#7	Director	-------	11-3/8"	22-3/4"	-------	35-1/2"	35-1/2"
#8	Director	-------	11-5/16"	22-1/2"	-------	35-3/8"	35-3/8"
#9	Director	-------	11-1/4"	22-1/4"	-------	35-1/4"	35-1/4"
#10	Director	-------	11-3/16"	22"	-------	35-1/8"	35-1/8"
#11	Director	-------	11-1/8"	21-3/4"	-------	35"	35"

All antennas are supplied with one of each size element, except the A147-22 Power Pack has two of each size element. Cutting tolerance is 1/16" for all elements.

ASSEMBLY INSTRUCTIONS

BOOM ASSEMBLY, A147-11 and A220-11: Slide the 7/8" section(s) into the 1" center section, as far as the single black line. To align the boom sections, insert a 2" bolt through one hole in each section, and sight along the boom. Tighten the sections securely with the 1" telescope clamp(s).

ELEMENT ASSEMBLY: The elements for the A147-11, A220-11 and A147-4 (not including the dipole) are taped in one bundle. They are progressively shorter to improve bandwidth. For the A147-4 and A449-6, mount the reflector (longest element) at the U-bolt end of the boom. The A147-11 reflector may be mounted at either end of the boom. For the A220-11, mount the reflector at the end of the 1" boom section. Mount the dipole next, then each progressively shorter director, up to the front director (shortest element), figure 1. All but the two end elements and dipole are preassembled on the booms of the A449-11 and A449-6. Mount them in the proper order as outlined above. Align all elements and tighten securely. Press the plastic caps onto the dipole and boom ends.

IOUNT: The A147-4 and A449-6 use a single U-bolt and bracket assembly, figure 2. The and A220-11 use a single U-bolt and bracket assembly, figure 3. The A147-11 uses a 4"x6" ounted between the number 5 and 6 elements, figure 4. All of the antennas may be mounted r horizontal or vertical polarization. For vertical polarization, mount them with the Reddi Match rods pointing up. Keep the mast mount bracket on the opposite side of the boom from the elements. This will help to minimize pattern distortion from metallic masts.

EED LINE: Attach a standard PL-259 coax fitting to your 52-ohm feed cable, and connect it to the coax fitting on the Reddi Match, figure 5.

TUNING: The Reddi Match is set at the factory for 52-ohm and center band operation. For best results, it should be individually tuned at your site, by using a good quality standing wave ratio bridge. It is not necessary to cut your feed line or prune it to a particular length; any length feed cable may be used with the beams. However, the cable should be as short as possible to reduce feed line losses.

(1.) Insert the SWR bridge in the line between the transmitter and the antenna. For tuning, keep the bridge as close to the antenna as possible, to reduce possible false readings from the cable. Set the transmitter to your center operating frequency.

(2.) Adjust the bridge for maximum forward power. Check the standing wave ratio or reflected power with the bridge in the reverse position. Move away from the antenna when making measurements. If the SWR is high, loosen the tuning strap and adjust it slightly in either direction. If the SWR has increased, move the strap back to its original position and adjust in the opposite direction. If the SWR has dropped, repeat the adjustment procedure until there is little or no reflected power indicated on the bridge. Tighten the tuning strap securely.

(3.) When the antenna is completely assembled and tuned, tighten the feed line connections, tape them, and coat with a clear acrylic spray or equal. Run the coaxial feed line along the boom and down the mast. Use electrical tape to hold it in position.

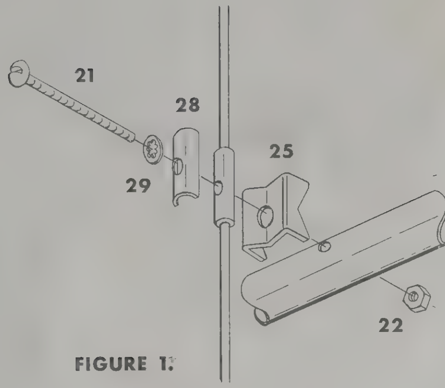

FIGURE 1.

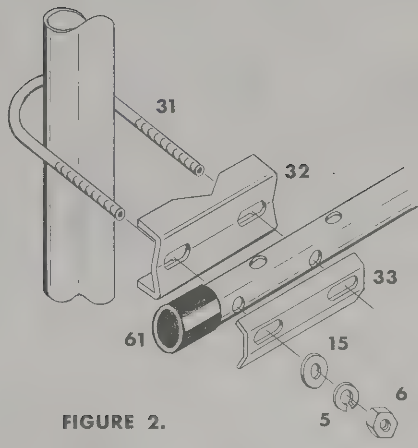

FIGURE 2.

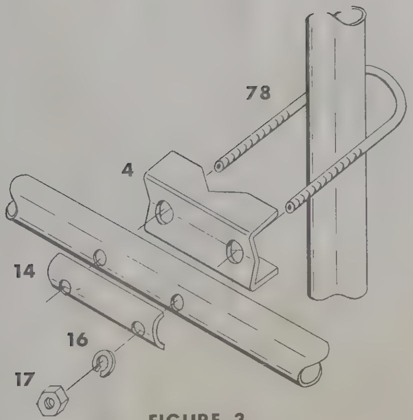

FIGURE 3.

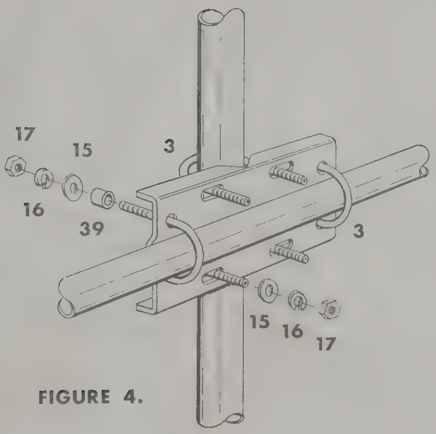

FIGURE 4.

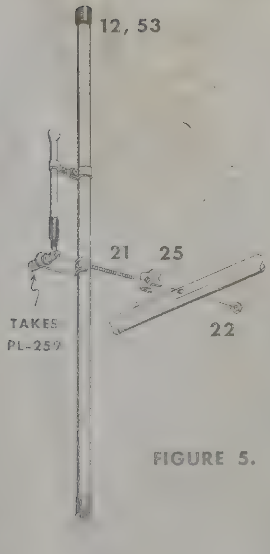

FIGURE 5.

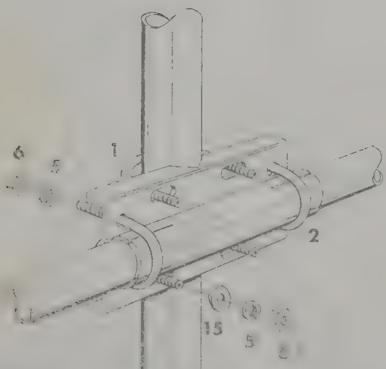

FIGURE 6.

STACKING KITS

PARTS LIST

DESCRIPTION	QUANTITY			
	A147-VPK	A14-VPK	A220-VPK	A449-VPK
1-1/2"x 41" boom sections	2	-	-	-
1-1/2"x 27" boom sections	-	2	2	-
1-1/4"x 33" boom	-	-	-	1
1-5/8"x 6" center splice	1	1	1	-
4"x 6" formed aluminum mast bracket	1	1	1	-
Coax harness assembly	1	1	1	1

PARTS PACKAGE

PART NO.	DESCRIPTION	QUANTITY			
1	2" U-bolts	2	2	2	-
2	1-5/8" U-bolts	2	2	2	-
5	5/16" lock washers	8	8	8	2
6	5/16" hex nuts	8	8	8	2
13	1-1/4" plastic caps	-	-	-	2
15	1/4" flat steel washers	4	4	4	2
31	2"x 4" U-bolts	-	-	-	1
32	3-1/2" U-bolt bracket	-	-	-	1
33	3-1/2" U-bolt backing plate	-	-	-	1
46	1-1/2" plastic caps	2	2	2	-

STACKED ARRAYS: A147-22, A147-VPK, A14-VPK, A220-VPK, A449-VPK.
The following instructions apply to the A147-22 Power Pack and all of the VPK stacking kits. Refer to the single beam instructions for assembly and tuning of the individual antennas.

To assemble the A147-22, A147-VPK, A14-VPK and A220-VPK mounting booms, slide the 1-1/2" sections into the 1-5/8" center splice, as far as the single black line. The 4"x 6" mounting plate and U-bolts clamp the sections together, figure 6. The A449-VPK mounting boom uses a single U-bolt and bracket assembly in the center, figure 2.

Mount the antennas on the ends of the support boom, using Chart 1, Dimension A, for the proper spacing, which is measured center-to-center on the antenna booms. For mechanical balance, it is best to keep the antenna booms below the support boom. The Reddi Match rods should be on the same side of the antenna booms, and pointing up. Press the plastic caps onto the boom ends.

Attach an end of the stacking harness to each Reddi Match. Run the cable along the boom. Use electrical tape to hold it in position. Any excess cable in the harness should be coiled equally on each side of the center T-fitting. Connect your 52-ohm feed cable to the T-fitting.

To tune the array, it is only necessary to adjust one antenna Reddi Match, using the same procedure as for the single antenna. When the array is assembled and tuned, tighten all connections. Cable connectors may be taped, and covered with a clear acrylic spray or equal.

Two arrays can be mounted in a quad configuration by using the appropriate coaxial harness between the dual arrays, Chart 1. Use Dimension A for the vertical and horizontal spacing dimensions, which are measured center-to-center on the antenna booms.

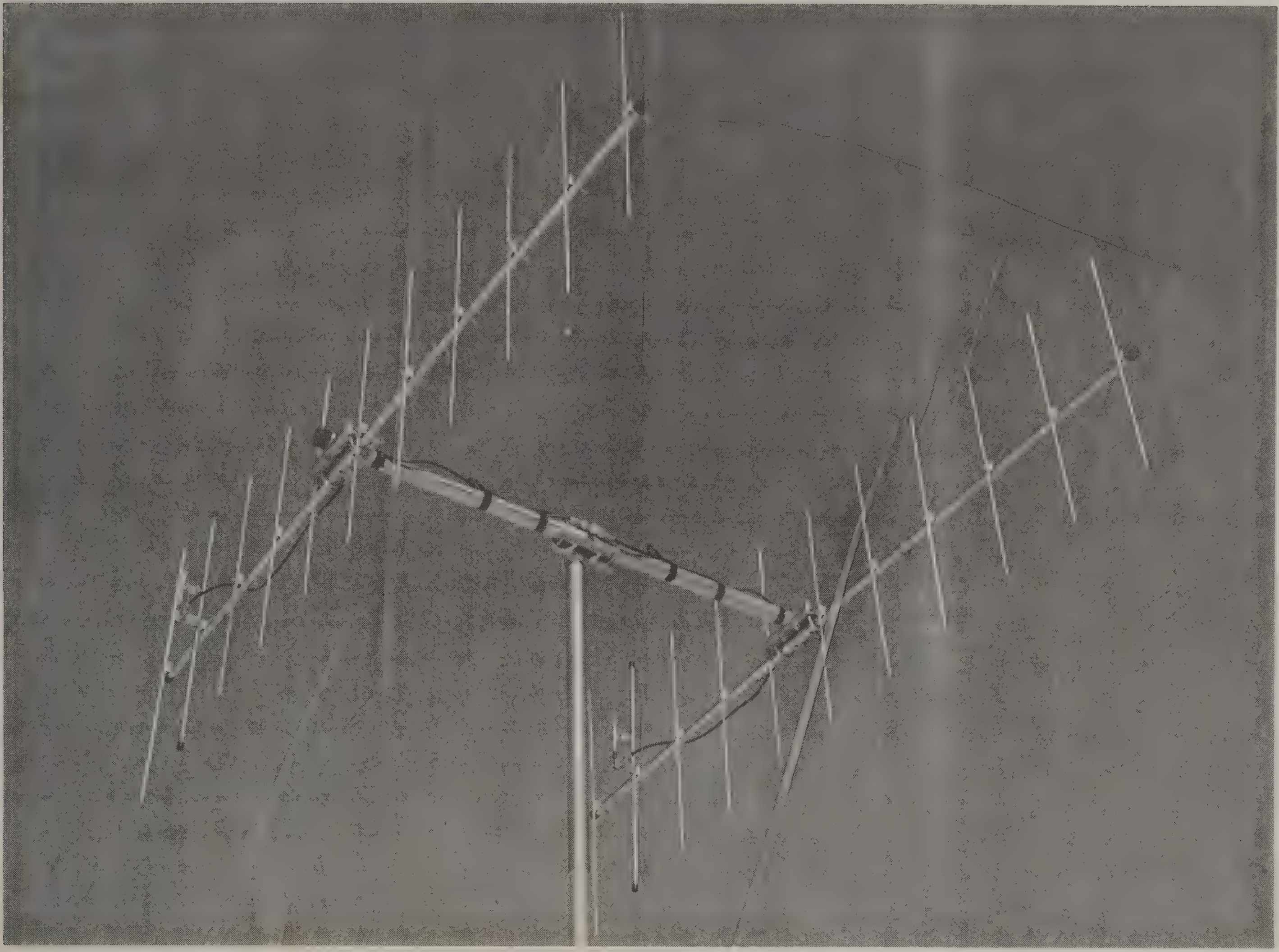

CHART 1.

ANTENNA MODEL NO.	DUAL STACKING KIT	HARNESS NO.	DIMENSION A
A147-11	A147-VPK	A147-SK	76"
A147-22	—	A147-SK	76"
A147-4	A14-VPK	A14-SK	50"
A220-11	A220-VPK	A220-SK	50"
A449-11	A449-VPK	A449-SK	25"
A449-6	A449-VPK	A449-SK	25"

securely. The A430-11 elements are preassembled on the boom.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

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ASSEMBLY INSTRUCTIONS A144-11, A144-7, A220-11, A430-11

PARTS LIST

DESCRIPTION	QUANTITY A144-11	A144-7	A220-11	A430-11
BOOMS:				
7/8" x 50" boom sections	2			
1" x 48" boom sections	1		1	
7/8" x 44" boom sections		1		
3/4" x 47" boom sections		1		
7/8" x 56" boom sections			1	
1" x 54" boom sections				1
ELEMENTS: 3/16" Solid Rod				
#1 Reflector	*40 1/4"	*40 1/4"	*26 1/4"	*13 3/4"
#2 Dipole w/Reddi Match	38 7/16"	38 7/16"	24 15/16"	12 7/8"
#3 Director	36 3/4"	36 3/4"	23 3/4"	12 1/4"
#4 Director	36 1/4"	36 1/4"	23 1/2"	12 1/8"
#5 Director	35 3/4"	35 3/4"	23 1/4"	12"
#6 Director	35 1/4"	35 1/4"	23"	11 7/8"
#7 Director	34 3/4"	34 3/4"	22 3/4"	11 3/4"
#8 Director	34 1/4"		22 1/2"	11 5/8"
#9 Director	33 3/4"		22 1/4"	11 1/2"
#10 Director	33 1/4"		22"	11 3/8"
#11 Director	32 3/4"		21 3/4"	11 1/8"
4" x 6" Formed aluminum mast bracket	1			

*Cutting tolerance of 1/16" on all elements

PART #	DESCRIPTION	PARTS PACKAGE QUANTITY A144-11	A144-7	A220-11	A430-11
3	1 1/2" U-bolts	4	1	1	1
4	1 1/2" U-bolt brackets		1	1	1
12	3/4" Plastic caps	2	3	2	
14	1 1/2" U-bolt backing plates		1	1	1
15	1/4" Flat steel washers	4			
16	1/4" Lock washers	8	2	2	2
17	1/4 - 20 Hex nuts	8	2	2	2
21	10 - 24 x 2" Bolts	10	6	10	10
22	10 - 24 Hex nuts	10	6	10	10
25	7/8" Formed aluminum brackets	10	6	10	10
28	Aluminum half washers	10	6	10	10
29	#10 Internal tooth lock washers	10	6	10	10
38	1" Plastic caps			1	2
39	3/8" Aluminum spacers	4			
53	1/2" Plastic caps				2
61	7/8" Plastic caps	2	1	1	
G-10 1/4	1" Telescope clamps	2		1	

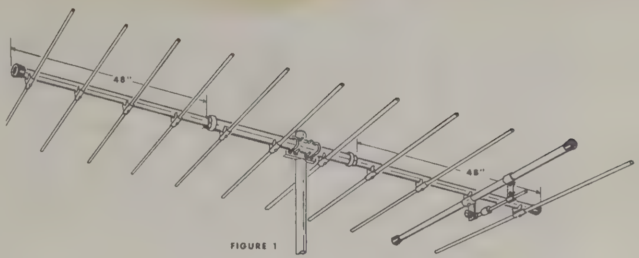

FIGURE 1

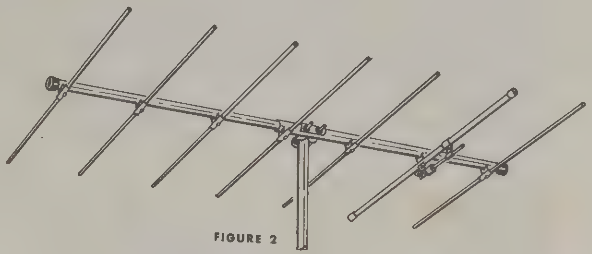

FIGURE 2

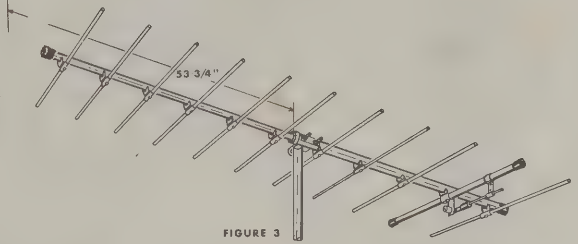

FIGURE 3

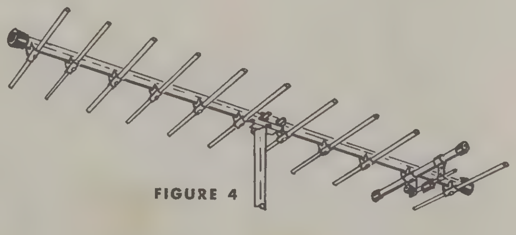

FIGURE 4

Your Cush Craft VHF/UHF Yagi is designed and manufactured to give top performance and trouble free service. The antenna will perform as specified if the instructions and suggestions are followed and if care is used in assembly and installation.

MASTING: The mast mount brackets will take up to a 1 1/2" O.D. mast. A 1 1/4" O.D. television type tubing is satisfactory for any of the single yagis.

MOUNTING: When mounting the yagis on the same mast with other dissimilar antennas they may be mounted within 4' of the other antenna. Generally it is best to mount these yagis above lower frequency antennas.

ROTATOR: A good quality television antenna rotator will easily handle any of these antennas.

LOCATION: of the antenna is very important. Surrounding objects such as trees, power lines, other antennas, etc. will seriously reduce efficiency. To minimize the effects of surrounding objects mount the antenna as high and in the clear as possible. If metal guy wires are used they should be broken with strain insulators installed approximately 4' from the top.

BOOM ASSEMBLY: For the A144-11 slide the 7/8" sections (as far as the black line) into the 1" center section and tighten securely with the 1" telescope clamps, figure 1. To align the boom sections insert a 2" bolt through one hole in each section and sight along the boom.

Assemble the two section A220-11 boom in the same manner as the A144-11 boom. The two A144-7 boom sections are secured by the #4 element and bracket. Select this element from the bundle and assemble it at the splice as shown in figures 2 and 5.

ELEMENT ASSEMBLY: The elements (not including the dipole) are taped in one bundle. They are progressively shorter to improve bandwidth. Mount the reflector (longest element) at the 7/8" end of the A144-7, the 1" end of the A220-11 and either end of the A144-11. Mount the dipole next, then each progressively shorter director up to the front director #7 or #11, which is the shortest element, figure 5. Align the elements and tighten securely. The A430-11 elements are preassembled on the boom.

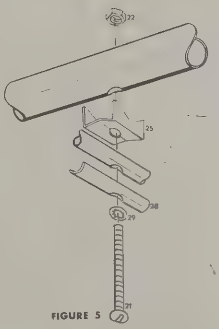

FIGURE 5

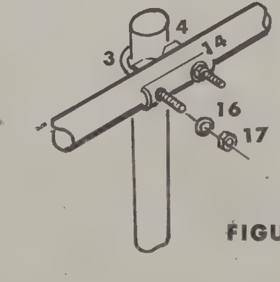

FIGURE 6

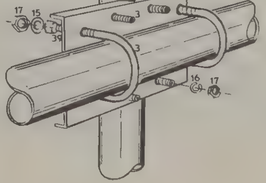

FIGURE 7

MAST MOUNT: The A144-7, A220-11 and A430-11 use a single U-bolt and bracket assembled as shown in figure 6. There are two sets of U-bolt holes in the booms, to give either horizontal or vertical polarization. The A144-11 used a 4" x 6" plate mounted between the No. 5 and 6 elements, figures 1 and 7. The boom may be rotated in the bracket to give either horizontal or vertical polarization.

FEED LINE: Attach a standard PL-259 coax fitting to your 52 ohm feed cable and connect it to the coax fitting on the Reddi Match, figure 8.

TUNING: The Reddi Match is set at the factory for 52 ohm coax and center band operation. For best results it should be individually tuned at your site, by using a good quality standing wave ratio bridge. It is not necessary to cut your feed line or prune it to a particular length. Any feed length cable may be used with the beam. Always make the cable as short as possible to reduce feed line loss.

(1.) Insert the standing wave ratio bridge in the line between the transmitter and the antenna. Set the transmitter to your center operating frequency.

(2.) Adjust the bridge for maximum forward power. Check the standing wave ratio with the bridge in the reverse position. If the VSWR is high loosen the tuning strap and adjust it slightly in either direction. Move away from the antenna and check the reading. If the VSWR has increased move the strap back to its original position and adjust in the opposite direction. If the SWR dropped repeat the adjustment procedure until there is little or no reflected power indicated on the bridge.

(3.) When the antenna is completely assembled and tuned tighten the feed line connections, tape them and coat with a clear acrylic spray or equal. Run the coaxial feed line along the boom and down the mast with electrical tape to hold it in position.

(4.) If necessary, re-align the elements and tighten all fasteners securely. Mount the plastic caps on the dipole and boom ends.

OPERATION: The A144-11 and A144-7 are cut at 144.5 mhz. They will cover the entire 2 meter band with a VSWR of less than 1.8-1, and the lower end with a VSWR of less than 1.5-1. The antennas may be cut for FM repeater or other use at high end of the band. For operation at the high end cut 1/4" from each end of each element for 1 mhz of change.

The A220-11 is cut at 221.0 mhz and will cover the entire band with a VSWR of 1.5-1 or less.

The A430-11 is cut at 432 mhz and will cover the most popular portion of the band with a VSWR of less than 1.5-1. For operation at the high end cut 1/32" from each end of each element for 1 mhz of change.

STACKING PROCEDURE

Any of the Cush Craft VHF/UHF beams may be stacked to give an additional 3 db gain, lower angle of radiation, and greater capture area. The following instructions apply to the Cush Craft coaxial stacking kits. This same procedure may also be used in fabricating your own stacking harness. Cable lengths Chart 1 Dimension B are the same for both RG-59/U and RG-11/U cables.

The stacking kits include two RG-59/U cable - Q sections, with PL-259's and T fitting.

(1.) Before connecting the harness tune the antennas separately by following the procedure for the single antennas.

(2.) Mount the two antennas on your mast with both Reddi Match units facing in the same direction, figure 9. Spacing between the antennas dimension A is given in Chart 1.

(3.) Attach an end of the stacking harness to each Reddi Match. Run the cable along the boom and mast. Connect your 52 ohm feed cable to the center T fitting, figure 9. Any excess cable in the harness can be coiled equally on each side of the center insulator and taped to the mast.

(4.) If it is necessary to tune the complete array, tune the lower antenna only. When the array is tuned tighten all connections. Cable connectors may be taped and covered with a clear acrylic spray or equal.

VPK: To assemble the vertical polarization kit slide the two 1 1/2" boom sections into the 1 5/8" center splice. The ubolts of the 4" x 6" mast mounting bracket serve as the splice clamps. Mount the antennas on the ends of the boom with both Reddi Match rods pointing in the same direction. Connect the cable and tune the array as outlined in the previous section.

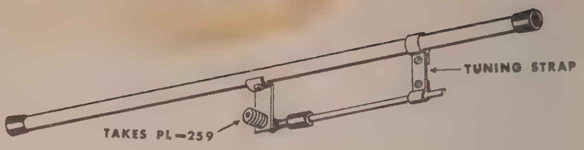

FIGURE 8

CHART #1

MODEL NO.	DIMENSION A	DIMENSION B
A144-11	79"	95 1/4"
A144-7	79"	67 3/4"
A220-11	50"	61 3/4"
A430-11	26"	32 1/4"

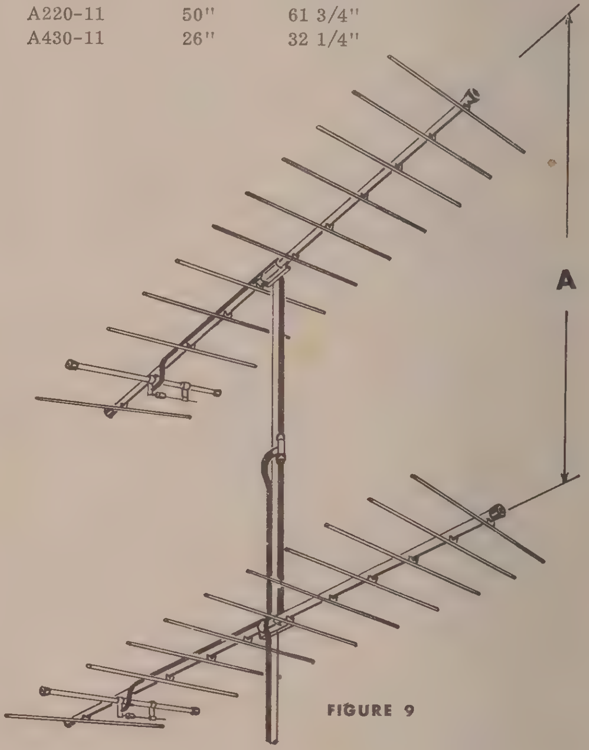

FIGURE 9

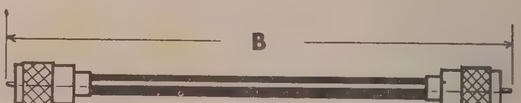

FIGURE 10

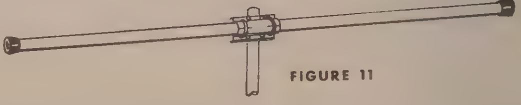

FIGURE 11

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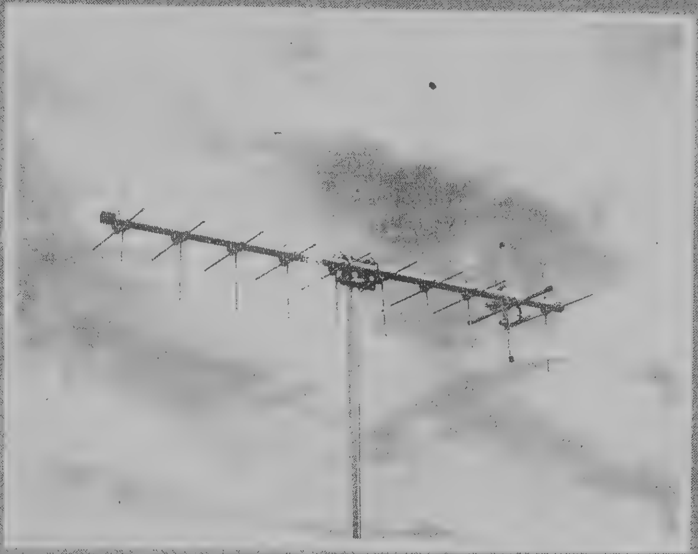
ASSEMBLY INSTRUCTIONS



VHF TWIST

A144-10T A144-20T
A147-20T P137-20T

VHF-782

PARTS PACKAGE

PART NO.	DESCRIPTION	QUANTITY A144-10T	QUANTITY A144-20T P137-20T	QUANTITY A147-20T
73	1-1/2" U-bolt x 3"	2	2	2
5	5/16" lock washer	--	--	--
6	5/16" hex nut	--	--	--
15	1/4" flat steel washer	8	8	8
16	1/4" lock washer	8	8	8
17	1/4" - 20 hex nut	8	8	8
21	10-24 x 2" RH machine screw	8	18	18
22	10-24 hex nut	8	18	18
25	7/8" formed alum. bracket	8	18	18
28	Alum. half washer	8	18	18
29	#10 internal-tooth lock washer	8	18	18
31	2" x 4" U-bolt	--	--	--
32	3-1/2" U-bolt bracket	--	--	--
33	3-1/2" U-bolt backing plate	--	--	--
38	1" plastic cap	--	--	--
39	3/8" aluminum spacer	4	4	4
53	1/2" plastic cap	4	4	4
61	7/8" plastic cap	1	2	2
G-9	7/8" telescope clamp	1	--	--
G-10	1" telescope clamp	1	2	2
3	1-1/2" U-bolt x 3-3/4"	2	2	2

PARTS LIST	DESCRIPTION	QUANTITY A144-10T	QUANTITY A144-20T P137-20T	QUANTITY A147-20T
MAST MOUNT	4" x 6" formed alum. plate	1	1	1
BOOM:	1" x 48" boom section	1	1	1
	7/8" x 48" boom section	--	2	2
	7/8" x 57" boom section	--	--	--
	7/8" x 24" boom section	1	--	--

ELEMENTS: 3/16" solid rod
Cutting tolerance of 1/16" on all elements

		A144-10T	A144-20T	A147-20T Vert.	A147-20T Horiz.
#1	Reflector	39-7/8"	39-7/8"	40"	40-1/4"
#2	Dipole w/Reddi Match	38"	38"	37-7/8"	38-1/2"
#3	Director	36"	36"	36"	36-1/2"
#4	Director	35-7/8"	35-7/8"	35-7/8"	36-3/8"
#5	Director	35-3/4"	35-3/4"	35-3/4"	36-1/4"
#6	Director	-------	35-5/8"	35-5/8"	36-1/8"
#7	Director	-------	35-1/2"	35-1/2"	36"
#8	Director	-------	35-3/8"	35-3/8"	35-7/8"
#9	Director	-------	35-1/4"	35-1/4"	35-3/4"
#10	Director	-------	35-1/8"	35-1/8"	35-5/8"

There are two elements for each length given above. The A147-20T has separate sets of elements cu for 144.5 and 146.5 MHz. The P137-20T elements are cut to length for the frequency ordered.

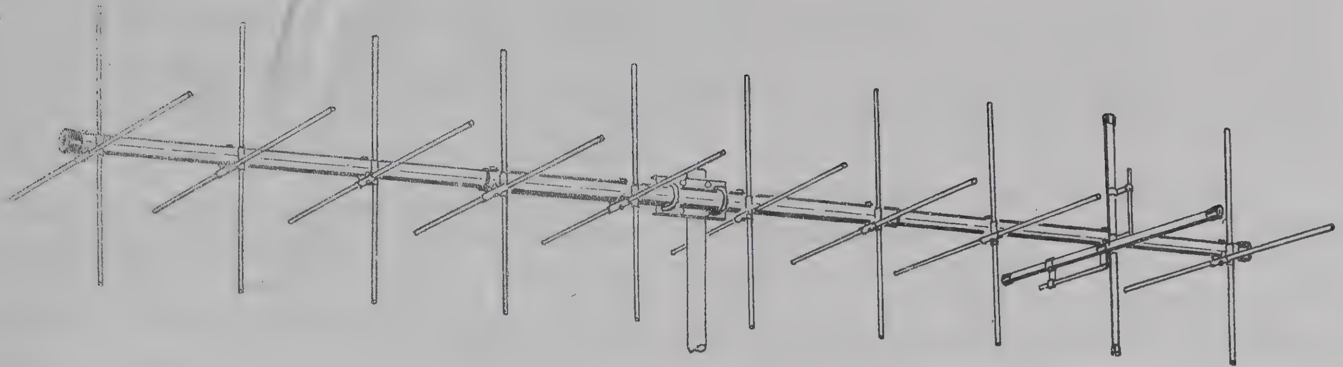
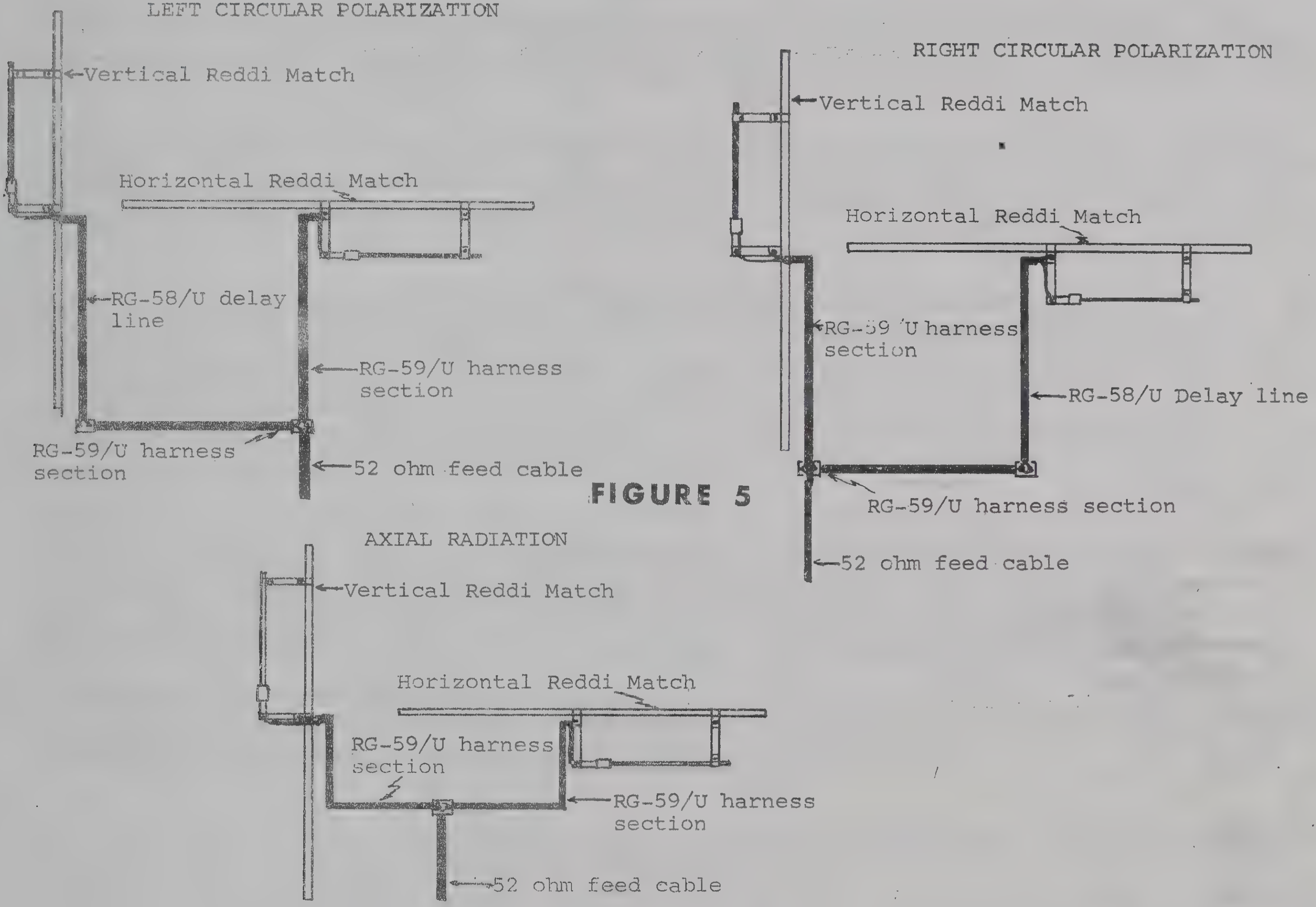


FIGURE 1



LEFT CIRCULAR POLARIZATION

RIGHT CIRCULAR POLARIZATION

AXIAL RADIATION

FIGURE 5

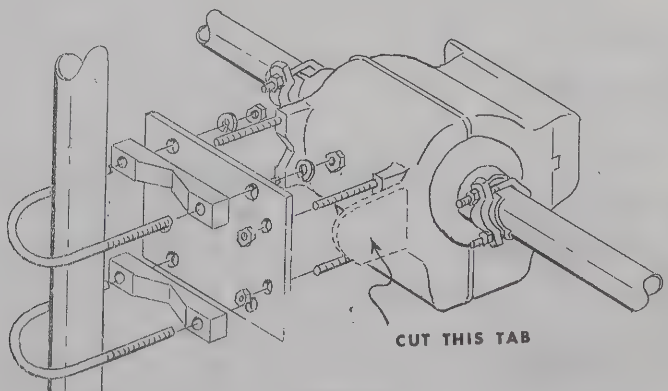


FIGURE 6

(4) When the antenna is completely assembled and tuned, tighten the feed line connections, tape them and coat them with a clear acrylic spray or equal. Run the coaxial feed line along the boom and down the mast with electrical tape to hold it in position.

The A144-20T. and A144-10T utilize our standard coaxial stacking harness of RG-59/U coax with a 1/4 wave length delay line to induce the various methods of polarization. The harness can be utilized to provide left or right hand circular polarization or axial radiation as outlined in the following paragraphs. This type of harness arrangement cannot be used with the A147-20T because the horizontal and vertical elements are cut to different frequencies.

For installations where only one mode of polarization is required, the phasing harness can be permanently mounted at the antenna using one of the methods shown in figure 5. With this arrangement, only one feed cable is required from the antenna/harness to the transmitter.

The delay line RG-58/U section can be removed and the stacking harness permanently mounted at the antenna, figure 5. In this case, a single feed cable is run from the transmitter to the stacking harness center to provide axial radiation - both horizontal and vertical polarization at the same time.

The complete phasing harness can be used to switch polarization at the operating position by running two exactly equal lengths of 52-ohm coax from the antenna to the operating position. The cables can be any length, but they must be equal. One cable is connected to the vertical Reddi Match and the other cable is connected to the horizontal Reddi Match. The harness is then transposed on the cables at the operating position as shown in figure 5, and outlined in the next paragraph. It will be necessary to utilize a short stub of any length 52-ohm coax connected from the transmitter to the harness center insulator.

Figure 5 (looking from the reflector end of the antenna) illustrates the cable connected with the delay line section to the vertical Reddi Match. In this case, the polarization is left circular. To change to right circular polarization, simply reverse the harness with the delay line (RG-58/U section) to the horizontal Reddi Match. For axial radiation, remove the delay line section and attach an end of the stacking harness to each antenna. Connect the feed cable to the center terminal and both the horizontal and vertical sections will radiate at the same time. Either horizontal or vertical polarization can be utilized by removing the phasing harness and connecting the feed line directly to the horizontal or vertical Reddi Match.

Coax phasing harness is supplied with all antennas except the A147-20T.

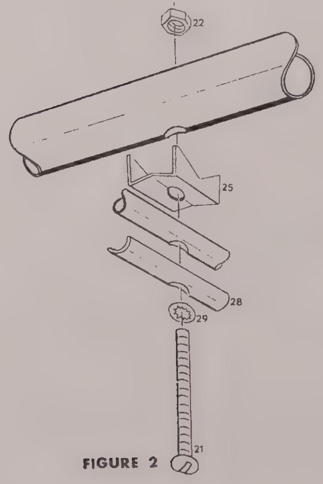


FIGURE 2

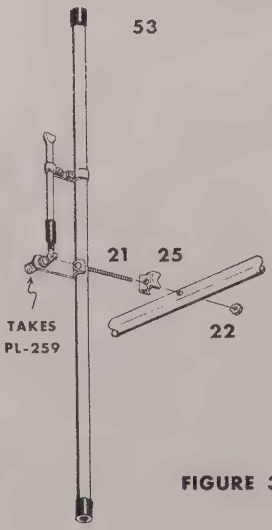


FIGURE 3.

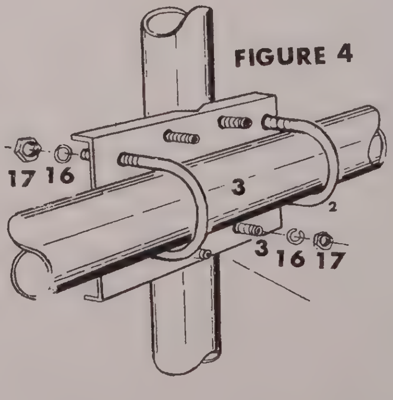


FIGURE 4

INSTALLATION SUGGESTIONS

Your Cush Craft Twist antenna is engineered and manufactured to give top performance and trouble free service. The antenna will perform as specified if the instructions and suggestions are followed and if care is used in assembly and installation.

MAST: The mast mount bracket will take up to a 1-1/2" O.D. mast. A 1-1/4" O.D. television type tubing is satisfactory for the twist.

LOCATION: The location of the antenna is very important. To minimize the effects of surrounding objects, mount the antenna as high and in the clear as possible.

ROTATOR: A good quality television rotor will easily handle the antenna. For tracking purposes, two mast through rotors can be used to give azimuth and elevation control. A balanced mechanical arrangement is desirable.

A14T-MB: The 50" boom section supports the A144-20T or A144-10T , figure 6. The mounting plate is pre-drilled to fit the Alliance U-100 Rotator. The kit includes a 50" x 1-3/8" boom, two 2" x 4" U-bolts, two 3-1/2" Vee blocks, four 5/16" lock washers, four 5/16" hex nuts and two 1-3/8" plastic caps. The hardware which comes with the U-100 completes the assembly.

BOOM ASSEMBLY: The A147-20T and A144-20T: Slide the 7/8" sections (as far as the black line) into the 1" center sections. A144-10T: Slide the 7/8" section (as far as the black line) into the 7/8" section. Be sure to align the element mounting holes. When the holes are aligned both ways, tighten the boom sections securely with the telescope clamp(s).

References to the A144-10T and A144-20T also apply to P157-10T and P157-20T.

ELEMENT ASSEMBLY: The elements (not including the dipole) are taped in two bundles. They are progressively shorter to improve bandwidth. The A147-20T element bundles are marked Hi-146 MHz and Lo-144.5 MHz. Mount the reflectors (longest elements) at one end of the boom. Mount dipoles next, then each progressively shorter element up to the front director #10, which is the shortest element, figures 1 & 2. The A147-20T Lo elements should be mounted for horizontal polarization.

MOUNTING: A144-20T and A147-20T: The 4" x 6" mounting plate is positioned between the No. 5 and 6 elements and on the opposite side of the boom from the vertical elements, figures 1 & 4. A144-10T: The 4" x 6" mounting plate is positioned behind the reflectors.

The A147-20T uses two separate 52-ohm feed lines. The harness/delay line is included with all other models. Before connecting the harness or feed line, tune the individual Reddi Match driven elements. When tuning the antenna at ground level, it can be mounted with the boom in a vertical position with the reflectors approximately 1 wave length from and parallel to the ground.

(1) Connect a 52-ohm feed cable to the driven element with a PL-259 fitting.

(2) Insert the standing wave ratio bridge in the line between the transmitter and the antenna. Set the transmitter to your center operating frequency.

(3) Adjust the bridge for maximum forward power. Check the standing wave ratio with the bridge in the reverse position. If the VSWR is high, loosen the tuning strap, move the strap a quarter of an inch either way and take a second VSWR reading. If the VSWR has increased, move the strap back to its original position and adjust in the opposite direction. If the VSWR dropped, repeat the adjustment procedure until there is little or no reflected power indicated on the bridge.

(4) When the antenna is completely assembled and tuned, tighten the feed line connections, tape them and coat them with a clear acrylic spray or equal. Run the coaxial feed line along the boom and down the mast with electrical tape to hold it in position.

The A144-20T and A144-10T utilize our standard coaxial stacking harness of RG-59/U coax with a 1/4 wave length delay line to induce the various methods of polarization. The harness can be utilized to provide left or right hand circular polarization or axial radiation as outlined in the following paragraphs. This type of harness arrangement cannot be used with the A147-20T because the horizontal and vertical elements are cut to different frequencies.

For installations where only one mode of polarization is required, the phasing harness can be permanently mounted at the antenna using one of the methods shown in figure 5. With this arrangement, only one feed cable is required from the antenna/harness to the transmitter.

The delay line RG-58/U section can be removed and the stacking harness permanently mounted at the antenna, figure 5. In this case, a single feed cable is run from the transmitter to the stacking harness center to provide axial radiation - both horizontal and vertical polarization at the same time.

The complete phasing harness can be used to switch polarization at the operating position by running two exactly equal lengths of 52-ohm coax from the antenna to the operating position. The cables can be any length, but they must be equal. One cable is connected to the vertical Reddi Match and the other cable is connected to the horizontal Reddi Match. The harness is then transposed on the cables at the operating position as shown in figure 5, and outlined in the next paragraph. It will be necessary to utilize a short stub of any length 52-ohm coax connected from the transmitter to the harness center insulator.

Figure 5 (looking from the reflector end of the antenna) illustrates the cable connected with the delay line section to the vertical Reddi Match. In this case, the polarization is left circular. To change to right circular polarization, simply reverse the harness with the delay line (RG-58/U section) to the horizontal Reddi Match. For axial radiation, remove the delay line section and attach an end of the stacking harness to each antenna. Connect the feed cable to the center terminal and both the horizontal and vertical sections will radiate at the same time. Either horizontal or vertical polarization can be utilized by removing the phasing harness and connecting the feed line directly to the horizontal or vertical Reddi Match.

Coax phasing harness is supplied with all antennas except the A147-20T.

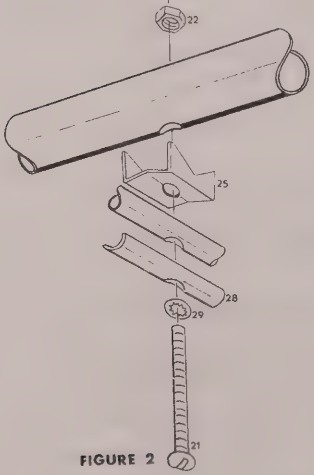


FIGURE 2

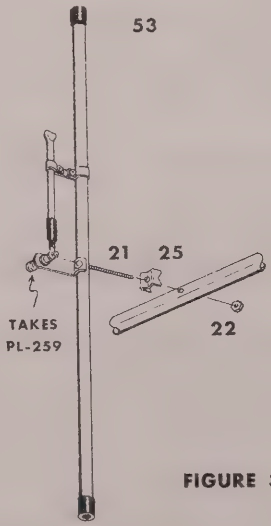


FIGURE 3.

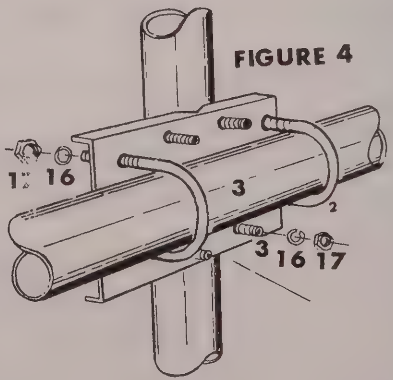
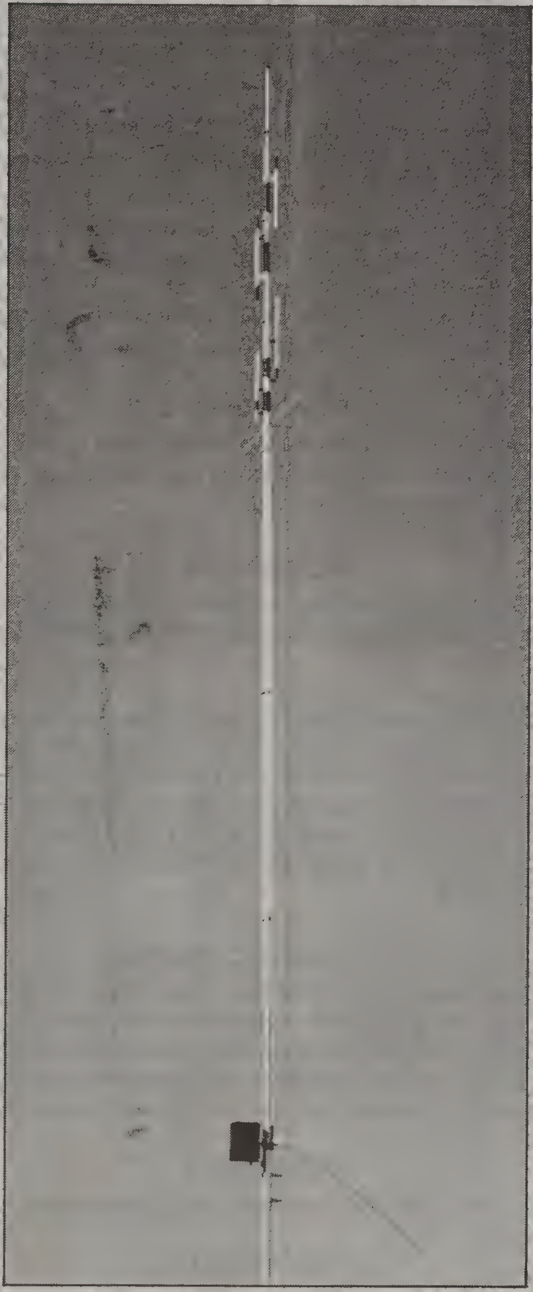


FIGURE 4

ASSEMBLY AND INSTALLATION



R5

10, 12, 15, 17, 20 METERS

cushcraft
CORPORATION

951361 (10/89)

WARNING

THIS ANTENNA IS AN ELECTRICAL CONDUCTOR. CONTACT WITH POWER LINES CAN RESULT IN DEATH OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTLY FALL. FOLLOW THE GUIDELINES FOR ANTENNA INSTALLATIONS RECOMMENDED BY THE U.S. CONSUMER PRODUCT SAFETY COMMISSION AND LISTED IN THE ENCLOSED PAMPHLET.

Your Cushcraft R5 vertical antenna is designed and manufactured to give trouble free service. The antenna will perform as specified if the instructions and suggestions are followed and care is used in assembly and installation. When checking the components received in you antenna package use the parts list on page 8. Parts are also listed beside each diagram. If you are unable to locate any tube or component, check the inside of all tubing. IMPORTANT: Save the weight label from the outside of the carton. Each antenna is weighed at the factory to verify the parts count. If you claim a missing part, you will be asked for the weight verification label.

PLANNING

Plan your installation carefully. If you use volunteer helpers be sure that they are qualified to assist you. Make certain everyone involved understands that you are the boss and that they must follow your instructions. If you have any doubts at all, employ a professional antenna installation company to install your antenna.

LOCATION

Extreme care must be used for your safety. Although the R5 will operate in almost any location, it will perform best if it is in the clear. Surrounding objects such as trees, power lines, other antennas, etc., will reduce its efficiency. Mount the antenna as high and in the clear as possible.

Your R5 is a half wavelength vertical which does not require traditional ground radials. Your roof top, balcony, garden, motor home, porch, deck, or tower top etc, are all suitable locations for the R5. Do not install the R5 over or in close proximity to a ground radial system since it may detune the antenna YOU MUST INSURE THAT NEITHER PEOPLE OR PETS CAN COME IN CONTACT WITH YOUR ANTENNA WHILE IT IS IN OPERATION. DEADLY VOLTAGES AND CURRENTS MAY EXIST. ALSO, SINCE THE EFFECTS OF EXPOSURE TO RF ARE NOT FULLY UNDERSTOOD, LONG TERM EXPOSURE TO INTENSE RF FIELDS IS NOT RECOMMENDED. THERE ARE FOUR WARNING STICKERS WHICH MUST BE ATTACHED TO THE COUNTERPOISE GROUND RADIALS AS SHOWN IN FIGURE 2.

SYSTEM GROUNDING

Direct grounding of the antenna, mast, and tower is very important. This serves as protection from lightning-strikes and static buildup, and from high voltage which is present in the radio equipment connected to the antenna. A good electrical connection should be made to one or more ground rods (or other extensive ground system) directly at the base of the tower or mast, using at least 10AWG ground wire and non-corrosive hardware. For details and safety standards, consult the National Electrical Code. You should also use a coaxial lightning arrester. Cushcraft offers several different models, such as the LAC-1, LAC-2 or the LAC-4 series.

ASSEMBLY

Assemble the antenna by following steps 1 through 6. After assembly, adjust the antenna, if necessay, by following the procedures in next paragraph.

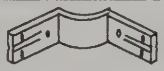
ADJUSTMENT

The dimensions shown in figure 4 normally allow proper operation on all bands. The following procedures compensate for variations from one installation to another. Adjustments should be made to the R5 beginning with the section between the base and the first trap. This controls 10 meter operation. Attach a good quality VSWR bridge in the coaxial cable as close to the antenna as possible. Measure the VSWR across the 10 meter band. If the lowest readings are not near your favorite frequencies the following adjustments may be made. If the frequency of the lowest VSWR is too high then lengthen dimension A by 1 inch (2.54 cm), (figure 4). This will lower the operating frequency. If you would like to raise the frequency of 10 meters, dimension A should be shortened. Check the VSWR to see if the lowest reading is on the proper frequency. If it is satisfactory you may use this procedure to adjust dimension B for 15 meters, C for 17 meters and dimension D for 20 meters. The antenna does not need to be adjusted for 12 meter operation. When the antenna is completely assembled and tuned check all fasteners to be sure that they are tight.

INSTALLATION

Following the guidelines in the LOCATION paragraph, place your antenna in its operating location. The base section will conveniently fit over a 1 7/8" (4.8 cm) OD or smaller tube. Now connect your feedline to the R5. Run the feedline to your operating position. Attach the feedline to your transceiver. If you plan to install the antenna in a salty or corrosive environment, you may want to consider coating it with a clear marine varnish or equivalent after assembly.

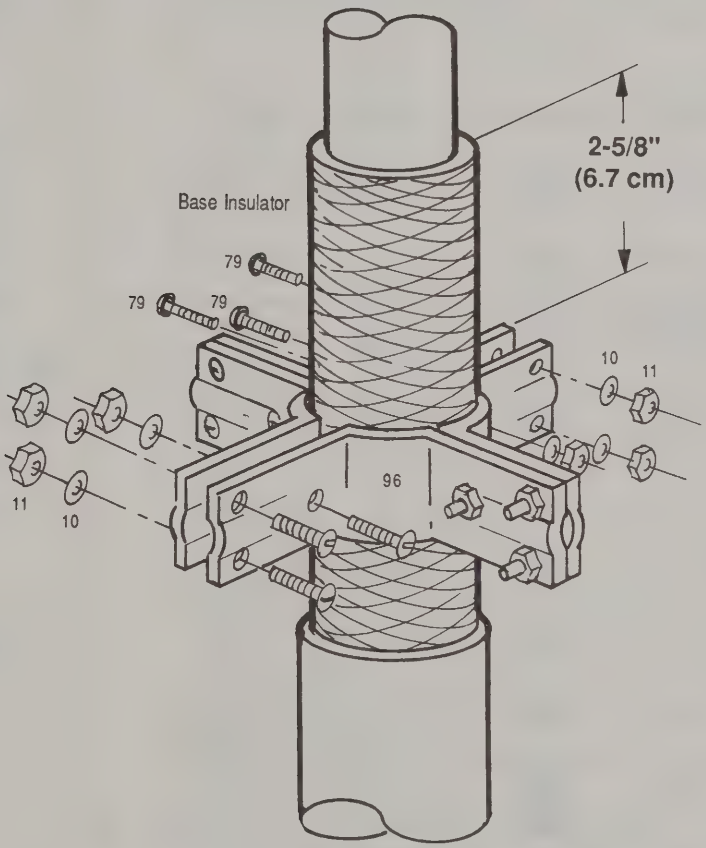
ROD BRACKET ASSEMBLY

KEY	P/N		DESC	SIZE	QTY
10	010010		LOCK WASHER	#8	12
11	010011		HEX NUT	8-32	12
79	010079		MACHINE SCREW	8-32 x 1/2" (1.27 cm)	12
96	202296		ROD BRACKET		4

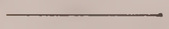
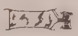
#1-ASSEMBLE GROUND ROD BRACKETS

Using figure 1 assemble the rod brackets. First assemble two rod brackets leaving the screws and nuts loose. Now assemble a second set of these brackets. Attach the two halves loosely around the base insulator.

FIGURE 1
ROD BRACKET ASSEMBLY



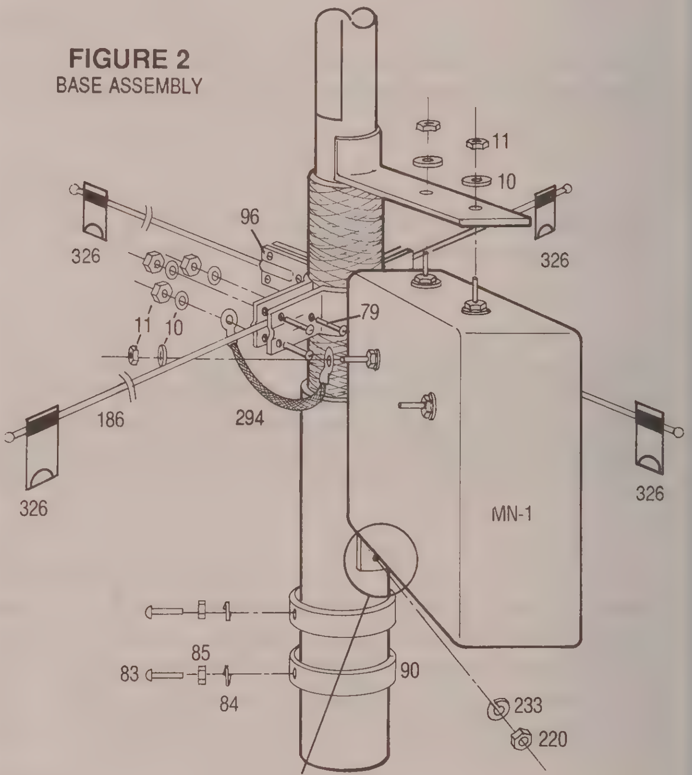
BASE ASSEMBLY PARTS

KEY	P/N		DESC	SIZE	QTY
83	010083		MACHINE SCREW	1/4-20 x 1 1/4" (3.2 cm)	2
84	010084		LOCK WASHER	1/4" (.6 cm)	2
85	010085		HEX NUT	1/4-20	2
90	200090		MAST MT. RING		2
96	202296		ROD BRACKET		4
294	192294		JUMPER STRAP		1
79	010079		MACHINE SCREW	8-32 x 1/2" (1.27 cm)	12
10	010010		LOCK WASHER	#8	15
11	010011		HEX NUT	8-32	15
233	010233		LOCK WASHER	#10	1
220	010220		HEX NUT	10-24	1
186	221186		IG ROD	.1" x 48" (.25 x 122 cm)	4
326	290326		WARNING LABEL		4
116	240116		SILICONE PACKET		1
115	050115		CONNECTOR BOOT		1
	MN-1		IMPEDANCE MATCHING ASSEMBLY		1

#2 - ASSEMBLE BASE

Referring to figure 2, attach the Impedance Matching Box (MN-1) to the radiator bracket as shown. To do this you may have to rotate the radial rod bracket assembly slightly if it is in the way. Holding the box with the pre-attached bracket on the bottom and next to the mast mount tube, lift the box so the mounting bolts on the top of the box go through the holes in the upper mounting bracket. Attach the bottom of the box to the protruding screw (figure 3). Attach braid 294 between the box and the rod brackets as shown. Next assemble and position the mast mount rings (90). Be sure the locking screws in the mast mount ring go through the pre-drilled holes in the R5 base (figure 3A). The IG rods should be attached later during step 5.

FIGURE 2
BASE ASSEMBLY



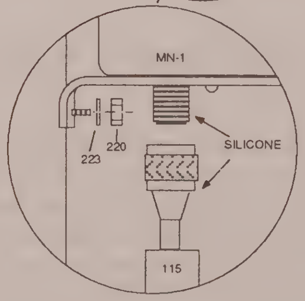
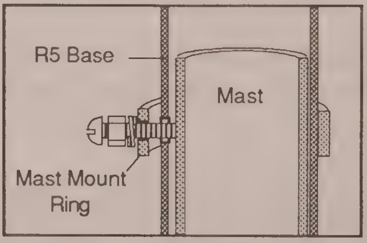


FIGURE 3
FEEDLINE CONNECTION

Oversized connector hole at base of black box is for moisture drainage.

FIGURE 3A
MAST MOUNT RING



GENERAL INSTALLATION INSTRUCTIONS FOR MAST MOUNTED ANTENNAS

1. Assemble your new antenna on the ground at the installation site. Keep separate assembly instructions that come with it. Large CB and Amateur beams may have to be finally assembled on the tower or mast.
2. On the ground, clamp antenna to mast, pull enough coaxial cable and connect to antenna.
3. To insure that a mast does not fall the "wrong way" if it should get away during the installation or takedown, durable non-conductive rope should be secured at each two foot level as the mast is raised. The boss stands in a position where he can yank or pull the ropes if the need arises to *deflect* the falling mast away from hazards (such as power lines) into a "safe fall" (such as a yard or driveway). The ropes are tied taut at the base of the mast after installation and in place at the various levels.
4. Install selected mounting bracket.
5. If you are going to use guy wire installation instead of a mounting bracket:
   - install guy anchor bolts
   - estimate length of guy wire and cut
   - attach a mast using guy ring.
6. Carefully take antenna and mast assembly to mounting bracket and insert. Tighten clamp bolts. In case of guyed installation, it will be necessary to have at least a second person hold the mast upright while the guy wires are attached and tightened to the anchor bolts.
7. Install self-adhering "DANGER" label packaged in antenna hardware kit at eye level on your mast.

   Install ground rod to drain off static electricity build up and connect ground wire to mast and ground rod. Use special ground rods, not a spare piece of pipe.

EXAMPLE OF ANTENNA GROUNDING AS PER NATIONAL ELECTRICAL CODE INSTRUCTIONS

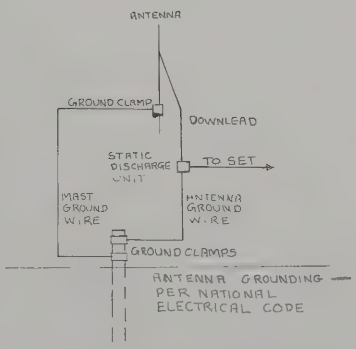
a. Use No. 10AWG copper or No. 8 AWG aluminum or No. 10 AWG copper-clad steel or bronze wire, or larger as ground wires for both mast and lead-in. Securely clamp the wire to the bottom of the mast.

b. Secure lead-in wire from antenna to antenna discharge unit and mast ground wire to house with stand-off insulators spaced from 4 feet (1.22 meters) to 6 feet (1.83 meters) apart.

c. Mount antenna discharge unit as close as possible to where the lead-in wire enters the house.

9. Drill a hole in wall (CAREFUL! there are wires in that wall!) near set just large enough to permit entry of cable.
10. Punch cable through hole and form a rain drip loop close to where it enters house.
11. Puts a small amount of caulking around cable where it enters house to keep out drafts.
12. Install static electricity discharge unit.
13. Connect antenna cable to set.

You should not attempt to raise a mast in excess of 30 feet in height/length (not including the antenna proper) in a fully-extended condition. Thirty to fifty foot tubular masts must be elevated a section at a time with the base or outer section secured in place with guy wires.
GET PROFESSIONAL HELP.



WARNING
INSTALLATION OF THIS PRODUCT NEAR POWER LINES IS DANGEROUS. FOR YOUR SAFETY, FOLLOW THE ENCLOSED INSTALLATION DIRECTIONS.

HOW TO INSTALL YOUR OUTDOOR ANTENNA SAFELY

IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE U.S. CONSUMER PRODUCT SAFETY COMMISSION

THESE SAFETY RECOMMENDATIONS APPLY TO ALL CUSHCRAFT CB, TV, AMATEUR AND GENERAL PURPOSE COMMUNICATION ANTENNAS.

YOU, YOUR ANTENNA, AND SAFETY

Each year hundreds of people are killed, mutilated or receive severe permanent injuries when attempting to install an antenna. In many of these cases, the victim was aware of the danger of electrocution, but did not take adequate steps to avoid the hazard.

For your safety, and to help you achieve a good installation, please **READ** and **FOLLOW** the safety precautions below: **THEY MAY SAVE YOUR LIFE!**

1. If you are installing an antenna for the first time, please, for your own safety as well as others, seek PROFESSIONAL ASSISTANCE. Consult your dealer. He can explain which mounting method to use for the size and type antenna you are about to install.
2. Select your installation site with safety, as well as performance, in mind. (Detailed information on Site Selection appears in a separate section of this booklet.) **REMEMBER:** ELECTRIC POWER LINES AND PHONE LINES LOOK ALIKE. FOR YOUR SAFETY, ASSUME THAT ANY OVERHEAD LINES CAN KILL YOU.
3. Call your electric power company. Tell them your plans and ask them to come look at your proposed installation. This is a little inconvenience, considering **YOUR LIFE IS AT STAKE.**
4. Plan your installation procedure carefully and completely *before* you begin. Successful raising of a mast or tower is largely a matter of coordination. Each person should be assigned to a specific task, and should know what to do and when to do it. One person should be designated as the "boss" of the operation to call out instructions and watch for signs of trouble.
5. When installing your antenna, **REMEMBER:**
   DO NOT us a metal ladder.
   DO NOT work on a wet or windy day.
   DO dress properly—shoes with rubber soles and heels, rubber gloves, long sleeve shirt or jacket.
6. If the assembly starts to drop, get away from it and let it fall. **REMEMBER:** The antenna, mast, cable, and metal guy wires are all excellent conductors of electrical current. Even the *slightest touch* of any of these parts to a power line completes an electrical path through the antennas and the installer—**THAT'S YOU!**
7. If any part of the antenna system should come in contact with a power line—**DON'T TOUCH IT OR TRY TO REMOVE IT YOURSELF. CALL YOUR LOCAL POWER COMPANY.** They will remove it safely.
8. If an accident should occur with the power lines—

   DON'T grab hold of the person in contact with the antenna and power line or you, too will be electrocuted. Use a DRY board, stick or rope to push or pull the victim away from the antenna. If the victim has stopped breathing, after moving, administer artificial respiration—and stay with it. Have someone call for medical help.

cushcraft
CORPORATION
THE ANTENNA COMPANY
P.O. BOX 4680, MANCHESTER, N.H. 03108

SITE SELECTION:

Before attempting to install your antenna, think where you can best place your antenna for *safety* and performance.

To determine a *safe* distance from wires, power lines and trees:

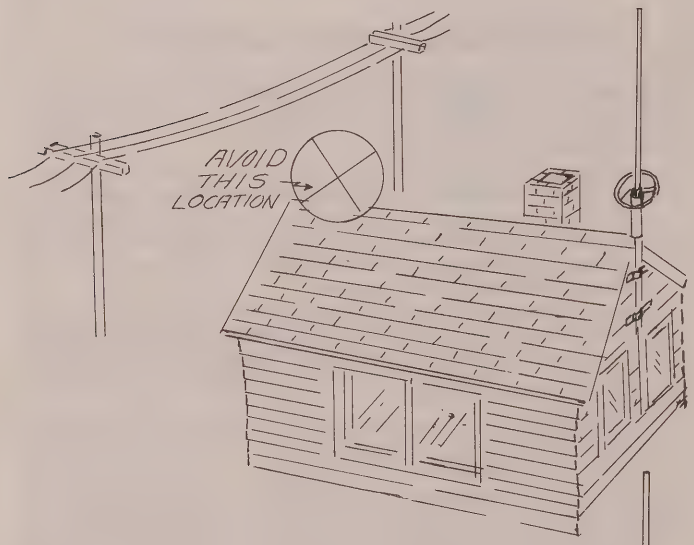
1. Measure the height of your antenna
2. Add this length to the length of your tower or mast, and then
3. Double this total for the minimum recommended *safe* distance.

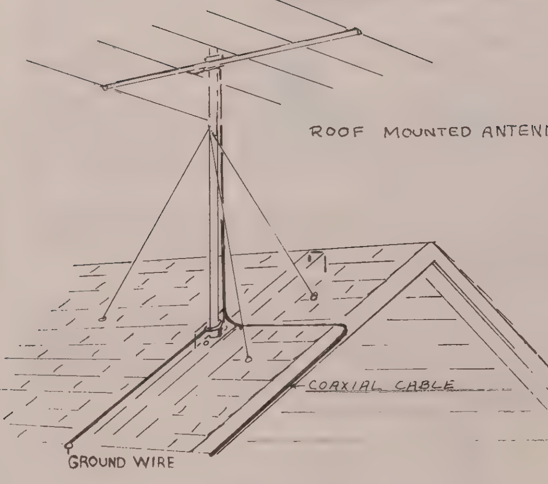
If you are unable to maintain this safe distance, **STOP!** GET PROFESSIONAL HELP. Many antennas are supported by pipe masts attached to the chimney, roof, or side of the house. Generally, the higher the antenna is above ground, the better it performs. Good practice is to install your antenna about 5 to 10 feet above the roof line and away from power lines and obstructions. Remember that the FCC limits your antenna height to 60 feet. If possible, find a mounting place directly above your set, where the antenna wire can take a short, vertical drop on the outside of the house for entry through a wall or window near the set. Your dealer carries a complete line of installation hardware.

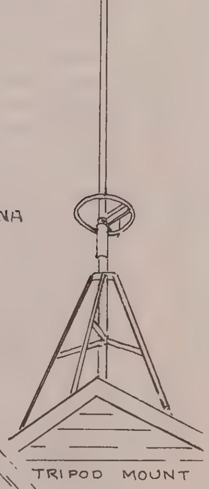
The safe distance from power lines should be at least twice the height of antenna and the mast combined.

CHOOSE A PROPER SUPPORT AND MOUNTING METHOD:

These are three types of supporting structures commonly used in antenna installations. Illustrations of these devices and various mounting methods follow.







ROOF MOUNTING

The swivel feature of "universal" type mounting brackets makes a convenient antenna mount for flat or peaked roofs. One clamp type bracket is used with 3 or 4 guy wires equally spaced around the mast and anchored to the roof or eaves by eyebolts. Apply roofing compound around the base of the bracket, screws and eyebolts for moisture sealing.

THESE MOUNTING STRUCTURES CAN BE FREE STANDING OR ALONG SIDE OF BUILDING

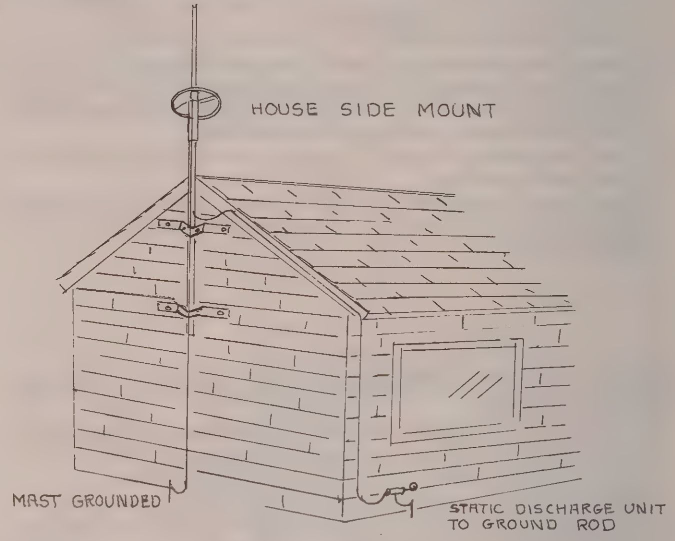
Guy wires should be equally spaced in at least three directions. Use at least three guy wires for each 10 foot section of mast.

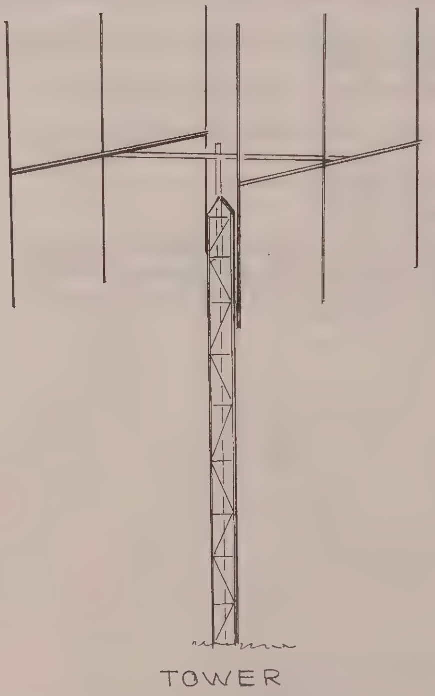
SIDE OF HOUSE MOUNT

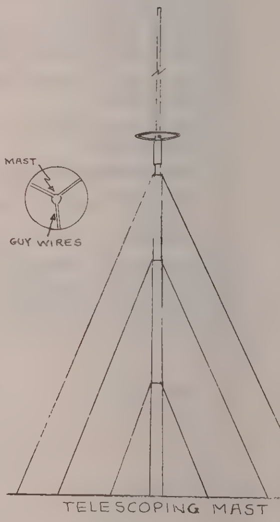
The safe distance from power lines is at least twice the height of antenna and the mast combined.

SIDE OF HOUSE MOUNTING

Where roof overhang is not excessive, the side of the house provides a convenient mounting. Position the brackets over a stud if possible, one above the other, and space two or three feet apart. For metal siding, first mark mounting holes, then drill pilot holes through the siding to accept mounting screws.

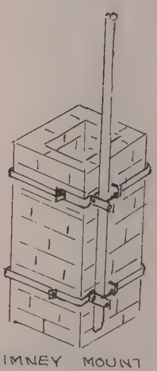




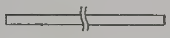
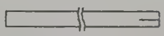
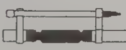
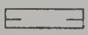


CHIMNEY MOUNTING

The chimney is often an easy and convenient mounting place. But the chimney must be strong enough to support the antenna in high winds. Do not use a chimney that has loose bricks or mortar. A good chimney mount makes use of a 5 or 10 foot 1¼" diameter steel mast, and a heavy duty two strap clamp-type bracket. Install the upper bracket just below the top course of bricks, and the lower bracket two or three feet below the upper bracket. For maximum strength, space the brackets as far apart as possible.



VERTICAL ASSEMBLY PARTS

KEY	P/N		DESC	SIZE	QTY
409	030409		WORM CLAMP	7/8" (2.22 cm)	1
410	030410		WORM CLAMP	1" (2.54 cm)	3
411	030411		WORM CLAMP	1 1/4" (3.2 cm)	1
412	030412		WORM CLAMP	1 1/2" (3.8 cm)	2
53	050053		PLASTIC CAP	1/2" (1.27 cm)	1
AF			ALUM TUBING	1/2 x 16" (1.3 X 40.6 cm)	1
AC			ALUM TUBING	1 1/8 x 48" (2.9 x 122 cm)	1
AB			ALUM TUBING	1 1/4 x 48" (3.2 x 122 cm)	1
AA			BASE SECTION	48" (122 cm)	1
TW			10 & 12 M TRAP		1
TR1			15 M TRAP		1
TR2			17 M TRAP		1
CS			ALUM TUBING	1" x 3-1/2" (2.54 X 8.9 cm)	1

#3
ASSEMBLE VERTICAL

When the base section assembly is completed, place worm clamp (412) over the top of the base tube (AA). Insert tube AB in 4 inches (10 cm) and tighten the clamp. Continue the same procedure with AC. Note the measurement points shown in figure 4 and then attach trap assemblies TW, TR1 and TR2. The arrows that are on the labels affixed to the traps must point up for assembly. The external trap capacitors should alternate from left to right as you assemble the antenna. Install tube AF with clamp 409 as shown. Use care in setting the radiator dimensions as shown on the drawing.

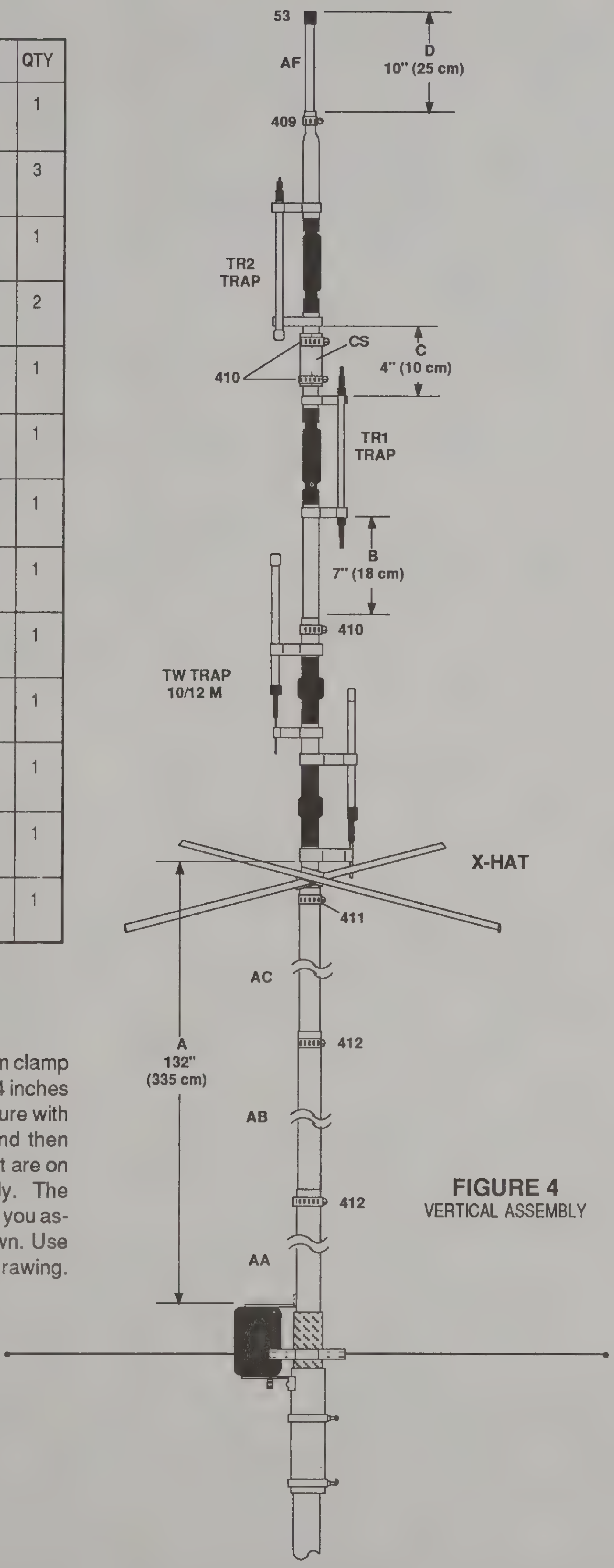


FIGURE 4
VERTICAL ASSEMBLY

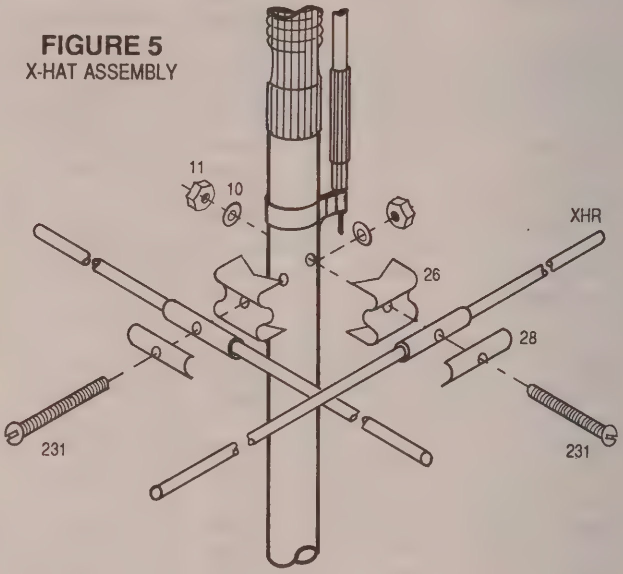
KEY	P/N		DESC	SIZE	QTY
26	190026		FORMED BRACKET	7/8" (2.2 cm)	2
XHR			X-HAT ROD	3/16 x 36" (.5 x 91.4 cm)	2
231	010231		MACHINE SCREW	8-32 x 1 3/4" (4.4 cm)	2
10	010010		LOCK WASHER	#8	2
11	010011		HEX NUT	8-32	2
28	190028		ALUM HALF WASHER		2

#4 - ASSEMBLE X-HAT

Assemble and attach the X-hat to trap TW as shown in figure 5.

FIGURE 5

X-HAT ASSEMBLY



#5 - ATTACH IG RODS

Attach the 48 inch (122 cm) IG rods to the rod bracket on the antenna base. Slip them into the slots on the end of the bracket and firmly tighten the machine screws and nuts (figures 1 and 2). Attach warning labels 326 to the ends of the IG rods as shown in figure 2.

#6 - FEEDLINE

We have provided a weatherproof boot for the PL-259 connector on your feedline. Follow figure 3 on page 3 to install it. Insert the antenna end of you coax through the small end of your connector boot. Many cables are very tight which results in an excellent weather seal. Attach the PL-259 to the end of your coax. Spread the silicone on the threads of the antenna connector. Silicone should not be spread on the center pin. Apply the remaining silicone to the outside of the connector. Slip the boot over the connector, until it touches the bracket.

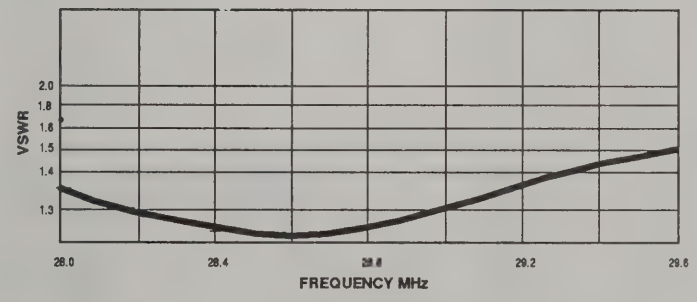
R5

SPECIFICATIONS

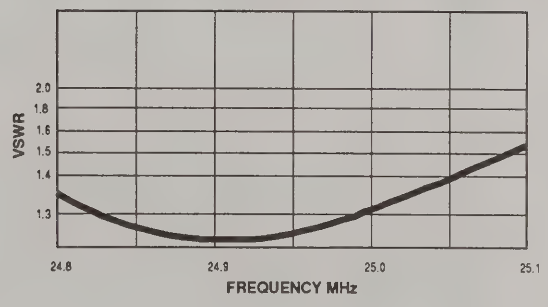
Frequency Meters	10, 12, 15, 17, 20
Electrical Wavelength	
Each band	Half-wave
VSWR 1.2:1 Typical	
2:1 Bandwidth	10m (2.0-1.7 MHz), 12m (100 KHz), 15m (400 KHz), 17m (100 KHz), 20m (300 KHz)
Power Rating, Watts PEP	1500
Radiation Angle Typical	At Horizon
Frequency Selection	Automatic
Horizontal Radiation Pattern Degrees	360°
Height, ft. (m)	17' (5.2)
Mast Size Range, in. (cm)	1.5-1.75 (3.8-4.4)
Wind Load, ft² (m²)	1.4 (.13)
Weight, lb. (kg)	8.7 (4)

TYPICAL VSWR CURVES

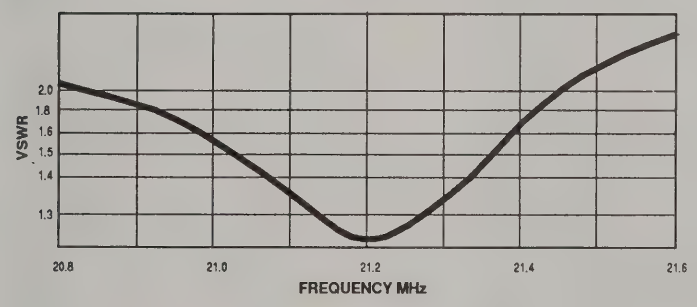
10 METERS



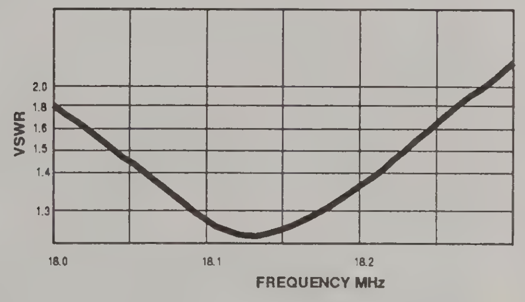
12 METERS



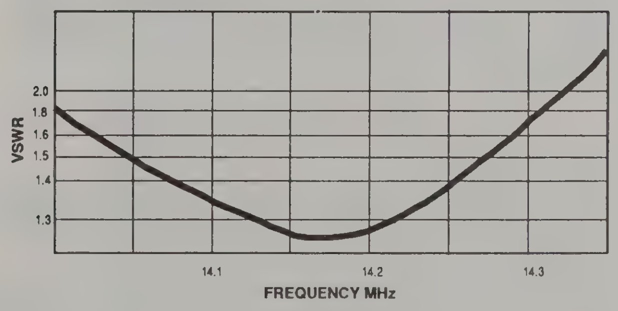
15 METERS



17 METERS



20 METERS



MASTER PARTS LIST

KEY	P/N	DESCRIPTION	QTY
AA		Base Section Assembly, 1 1/8" x 48" (2.8 x 121.9 cm)	1
AB		1 1/4" x 48" (3.2 x 121.9 cm) aluminum tube slotted one end	1
AC		1 1/8" x 48" (2.8 x 121.9 cm) aluminum tube slotted one end	1
AF		1/2" x 16" (1.27 x 40.6 cm) aluminum tube	1
XHR		3/16" x 36" (.4 x 91.4 cm) aluminum rod with #18 hole drilled mid point	2
CS		1" x 3-1/2" (2.54 x 8.9 cm) aluminum tube	1
186	221186	0.100" x 48" (.25 x 121.9 cm) stainless steel rod with ball tip one end	4
TW		10-12 meter Trap Assembly 30" (76 cm)	1
TR1		15 meter Trap Assembly 20" (51 cm)	1
TR2		17 meter Trap Assembly 18-1/4" (46.3 cm)	1
MN-1		Impedance Matching Box Assembly	1
79	010079	8-32 x 1/2" (1.27 cm) stainless steel machine screw	12
10	010010	#8 internal tooth lock washer	17
11	010011	8-32 stainless steel hex nut	17
83	010083	1/4-20 x 1 1/4" (3.2 cm) stainless steel machine screw	2
84	010084	1/4" (.63 cm) stainless steel split lock washer	2
85	010085	1/4-20 stainless steel hex nut	2
220	010220	10-24 stainless steel hex nut	1
231	010231	8-32 x 1 3/4" (4.44 cm) stainless steel machine screw	2
233	010233	#10 stainless steel split lock washer	1
409	030409	7/8" (2.22 cm) stainless steel worm clamp	1
410	030410	1" (2.54 cm) stainless steel worm clamp	3
411	030411	1 1/4" (3.17 cm) stainless steel worm clamp	1
412	030412	1 1/2" (3.81 cm) stainless steel worm clamp	2
115	050115	Vinyl connector boot	1
53	050053	1/2" (1.27 cm) black plastic cap	1
26	190026	7/8" (2.22 cm) formed aluminum bracket with #8 hole	2
28	190028	Aluminum half washer	2
296	202296	7/8" x 3 3/4" (2.22 x 9.52 cm) radial clamp	4
90	200090	Mast mounting ring	2
116	240116	Silicone grease packet	1
326	290326	Warning label	4
294	102294	Jumper Strap	1

LIMITED WARRANTY

Cushcraft Corporation, P.O. Box 4680, Manchester, New Hampshire 03108, warrants to the original consumer purchaser for one year from date of purchase that each Cushcraft antenna is free of defects in material or workmanship. If, in the judgement of Cushcraft, any such antenna is defective, then Cushcraft Corporation will, at its option, repair or replace the antenna at its expense within thirty days of the date the antenna is returned (at purchasers expense) to Cushcraft or one of its authorized representatives. This warranty is in lieu of all other expressed warranties, any implied warranty is limited in duration to one year. Cushcraft Corporation shall not be liable for any incidental or consequential damages which may result from a defect. Some states do not allow limitations on how long an implied warranty lasts or exclusions or limitations of incidental or consequential damages, so the above limitation and exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. This warranty does not extend to any products which have been subject to misuse, neglect, accident or improper installation. Any repairs or alterations outside of the Cushcraft factory will nullify this warranty.

cushcraft
CORPORATION
THE ANTENNA COMPANY

48 PERIMETER ROAD, MANCHESTER, NH 03108
603-627-7877 / TELEX 4949472 / FAX 603-627-1764

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

(Stainless Steel)
① - Get 2 - 2" U Bolts
w/Nuts
w/Lockwashers

~~② - Or short section of [illegible] 1½" mast~~

③ Get 2 Stainless
3/8 steel Bolts,
Nuts, Lockwasher
3½ to 4½
or
Threaded bolt
O'D of Pipe is 2.9"

④ Get 6 - PL 259
for outdoor use
Stainless steel

⑤ Get special drill
for 3/8 bolt
7/16"

⑥ Check on auto
Brake wrench

⑦ Paint (Silver outdoor)

⑧ Clear acrylic Spray

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CORPORATION

ASSEMBLY INSTRUCTIONS

VHF TWIST

A144-10T A144-20T
A147-20T A432-20T
P157-10T P157-20T

PARTS PACKAGE

PART NO.	DESCRIPTION	QUANTITY A144-10T	A144-20T	A147-20T	A432-20T
3	1-1/2" U-bolt	4	4	4	--
5	5/16" lock washer	--	--	--	2
6	5/16" hex nut	--	--	--	2
15	1/4" flat steel washer	8	8	8	2
16	1/4" lock washer	8	8	8	--
17	1/4" - 20 hex nut	8	8	8	--
21	10-24 x 2" RH machine screw	8	18	18	18
22	10-24 hex nut	8	18	18	18
25	7/8" formed alum. bracket	8	18	18	18
28	Alum. half washer	8	18	18	18
29	#10 internal-tooth lock washer	8	18	18	18
31	2" x 4" U-bolt	--	--	--	1
32	3-1/2" U-bolt bracket	--	--	--	1
33	3-1/2" U-bolt backing plate	--	--	--	1
38	1" plastic cap	--	--	--	1
39	3/8" aluminum spacer	4	4	4	--
53	1/2" plastic cap	4	4	4	4
61	7/8" plastic cap	1	2	2	1
G-9	7/8" telescope clamp	1	--	--	--
G-10	1" telescope clamp	1	2	2	--

PARTS LIST	DESCRIPTION	QUANTITY A144-10T	A144-20T	A147-20T	A432-20T
MAST MOUNT	4" x 6" formed alum. plate	1	1	1	--
BOOM:	1" x 48" boom section	1	1	1	--
	7/8" x 48" boom section	--	2	2	--
	7/8" x 57" boom section	--	--	--	1
	7/8" x 24" boom section	1	--	--	--

ELEMENTS: 3/16" solid rod
Cutting tolerance of 1/16" on all elements

		A144-10T	A144-20T	A147-20T		A432-20T
				Vert.	Horiz.	
#1	Reflector	39-7/8"	39-7/8"	40"	40-1/4"	13-3/8"
#2	Dipole w/Reddi Match	38"	38"	37-7/8"	38-1/2"	12-3/4"
#3	Director	36"	36"	36"	36-1/2"	12-1/16"
#4	Director	35-7/8"	35-7/8"	35-7/8"	36-3/8"	11-15/16"
#5	Director	35-3/4"	35-3/4"	35-3/4"	36-1/4"	11-13/16"
#6	Director	-------	35-5/8"	35-5/8"	36-1/8"	11-11/16"
#7	Director	-------	35-1/2"	35-1/2"	36"	11-9/16"
#8	Director	-------	35-3/8"	35-3/8"	35-7/8"	11-7/16"
#9	Director	-------	35-1/4"	35-1/4"	35-3/4"	11-5/16"
#10	Director	-------	35-1/8"	35-1/8"	35-5/8"	11-3/16"

There are two elements for each length given above. The A147-20T has a separate set of elements cut for 144.5 and 146.5 MHz.

Get short 1 1/2" mast to put into 1 5/8 I D Mast

INSTALLATION SUGGESTIONS

Your Cush Craft Twist antenna is engineered and manufactured to give top performance and trouble free service. The antenna will perform as specified if the instructions and suggestions are followed and if care is used in assembly and installation.

MAST: The mast mount bracket will take up to a 1-1/2" O.D. mast. A 1-1/4" O.D. television type tubing is satisfactory for the twist.

LOCATION: The location of the antenna is very important. To minimize the effects of surrounding objects, mount the antenna as high and in the clear as possible.

ROTATOR: A good quality television rotor will easily handle the antenna. For tracking purposes, two mast through rotors can be used to give azimuth and elevation control. A balanced mechanical arrangement is desirable.

A14T-MB: The 50" boom section supports the A144-20T or A144-10T and A432-20T, figure 6. The mounting plate is pre-drilled to fit the Alliance U-100 Rotator. The kit includes a 50" x 1-3/8" boom, two 2" x 4" U-bolts, two 3-1/2" Vee blocks, four 5/16" lock washers, four 5/16" hex nuts and two 1-3/8" plastic caps. The hardware which comes with the U-100 completes the assembly.

BOOM ASSEMBLY: The A147-20T and A144-20T: Slide the 7/8" sections (as far as the black line) into the 1" center sections. A144-10T: Slide the 7/8" section (as far as the black line) into the 7/8" section. Be sure to align the element mounting holes. When the holes are aligned both ways, tighten the boom sections securely with the telescope clamp(s). A432-20T: A single piece of 7/8" tubing constitutes the boom. This and all other references to the A432-20T also apply to the A450-20T. References to the A144-10T and A144-20T also apply to P157-10T and P157-20T.

ELEMENT ASSEMBLY: The elements (not including the dipole) are taped in two bundles. They are progressively shorter to improve bandwidth. The A147-20T element bundles are marked Hi-146 MHz and Lo-144.5 MHz. Mount the reflectors (longest elements) at one end of the boom. Mount dipoles next, then each progressively shorter element up to the front director #10, which is the shortest element, figures 1 & 2. The A147-20T Lo elements should be mounted for horizontal polarization.

MOUNTING: A144-20T and A147-20T: The 4" x 6" mounting plate is positioned between the No. 5 and 6 elements and on the opposite side of the boom from the vertical elements, figures 1 & 4. A144-10T: The 4" x 6" mounting plate is positioned behind the reflectors. A432-20T: A single U-bolt, located at the reflector end of the boom.

The A147-20T uses two separate 52-ohm feed lines. The harness/delay line is included with all other models. Before connecting the harness or feed line, tune the individual Reddi Match driven elements. When tuning the antenna at ground level, it can be mounted with the boom in a vertical position with the reflectors approximately 1 wave length from and parallel to the ground.

(1) Connect a 52-ohm feed cable to the driven element with a PL-259 fitting.

(2) Insert the standing wave ratio bridge in the line between the transmitter and the antenna. Set the transmitter to your center operating frequency.

(3) Adjust the bridge for maximum forward power. Check the standing wave ratio with the bridge in the reverse position. If the VSWR is high, loosen the tuning strap and reading. If the VSWR has increased, move the strap back to its original position and adjust in the opposite direction. If the SWR dropped, repeat the adjustment procedure until there is little or no reflected power indicated on the bridge.

(4) When the antenna is completely assembled and tuned, tighten the feed line connections, tape them and coat them with a clear acrylic spray or equal. Run the coaxial feed line along the boom and down the mast with electrical tape to hold it in position.

The A144-20T, A144-10T and A432-20T utilize our standard coaxial stacking harness of RG-59/U coax with a 1/4 wave length delay line to induce the various methods of polarization. The harness can be utilized to provide left or right hand circular polarization or axial radiation as outlined in the following paragraphs. This type of harness arrangement cannot be used with the A147-20T because the horizontal and vertical elements are cut to different frequencies.

For installations where only one mode of polarization is required, the phasing harness can be permanently mounted on the antenna using one of the methods shown in figure 4. With this arrangement, only one feed cable is required from the antenna/harness to the transmitter.

The delay line RG-59/U section can be removed and the stacking harness permanently mounted at the antenna, figure 6. In this case, a single feed cable is run from the transmitter to the stacking harness center to provide axial radiation - both horizontal and vertical polarization at the same time.

The complete phasing harness can be used to switch polarization at the operating position by running two exactly equal lengths of 52-ohm coax from the antenna to the operating position. The cables can be any length, but they must be equal. One cable is connected to the vertical Reddi Match and the other cable is connected to the horizontal Reddi Match. The harness is then transposed on the cables at the operating position as shown in figure 5, and outlined in the next paragraph. It will be necessary to utilize a short stub of any length 52-ohm coax connected from the transmitter to the harness center insulator.

Figure 5 (looking from the reflector end of the antenna) illustrates the cable connected with the delay line section to the vertical Reddi Match. In this case, the polarization is left circular. To change to right circular polarization, simply reverse the harness with the delay line (RG-58/U section) to the horizontal Reddi Match. For axial radiation, remove the delay line section and attach an end of the stacking harness to each antenna. Connect the feed cable to the center terminal and both the horizontal and vertical sections will radiate at the same time. Either horizontal or vertical polarization can be utilized by removing the phasing harness and connecting the feed line directly to the horizontal or vertical Reddi Match.

Coax phasing harness is supplied with all antennas except the A147-20T.

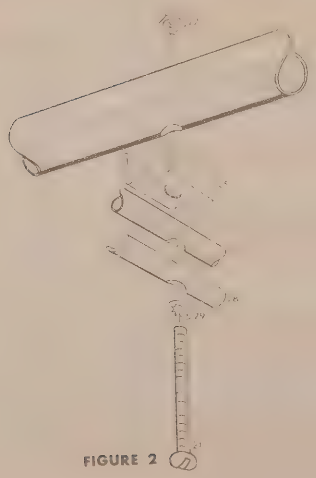


FIGURE 2

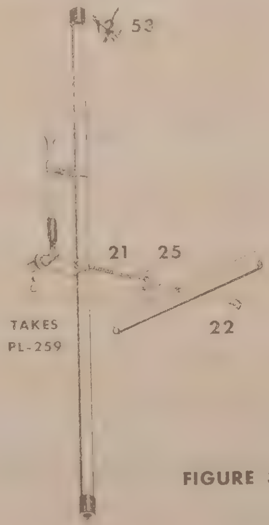


FIGURE 3.

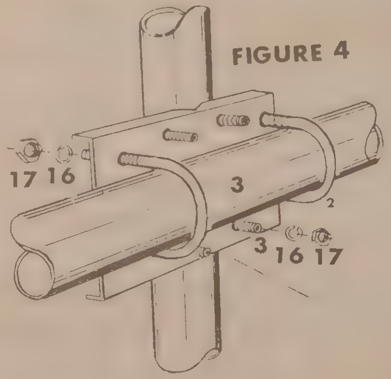


FIGURE 4

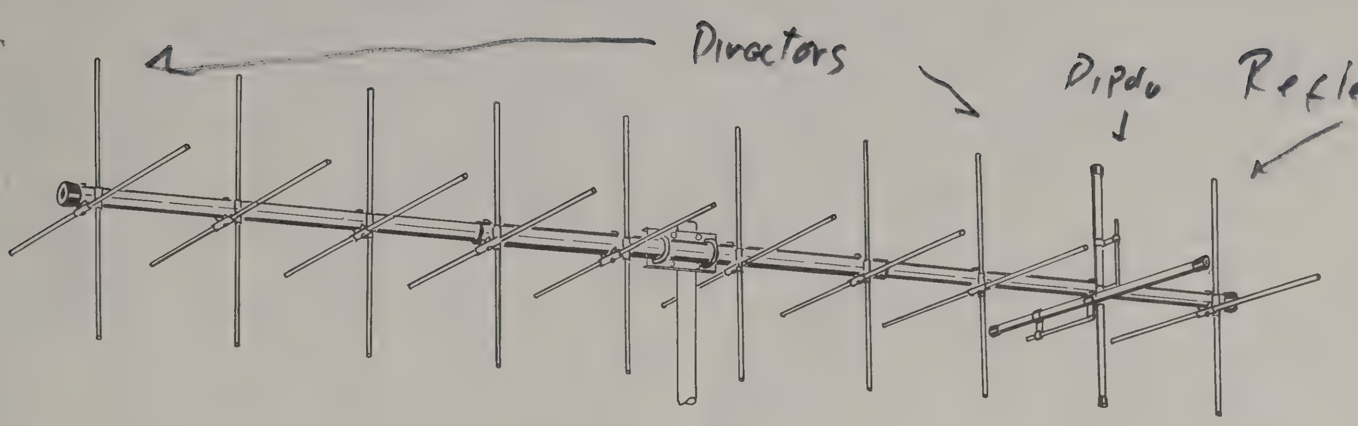


FIGURE 1

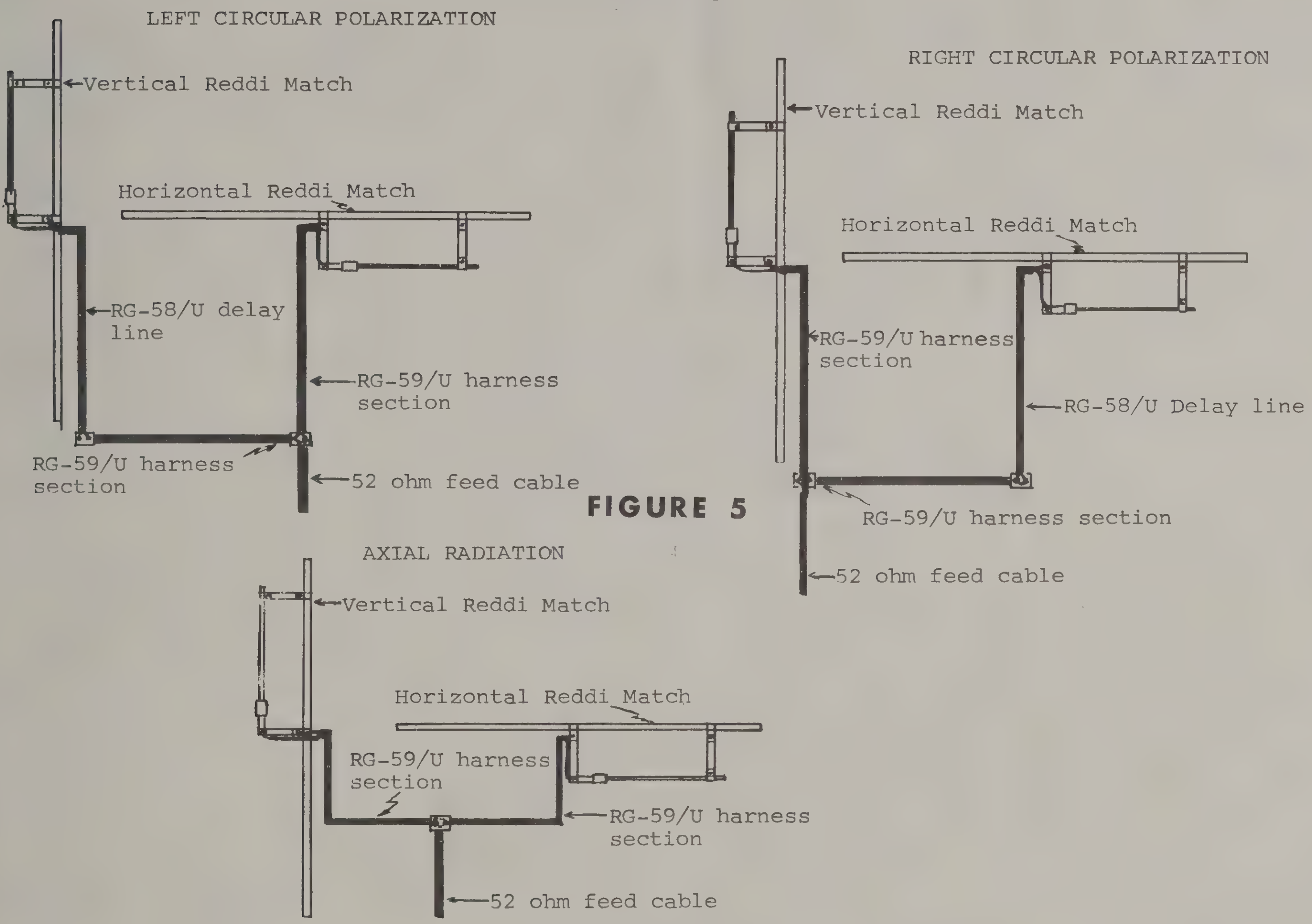


FIGURE 5

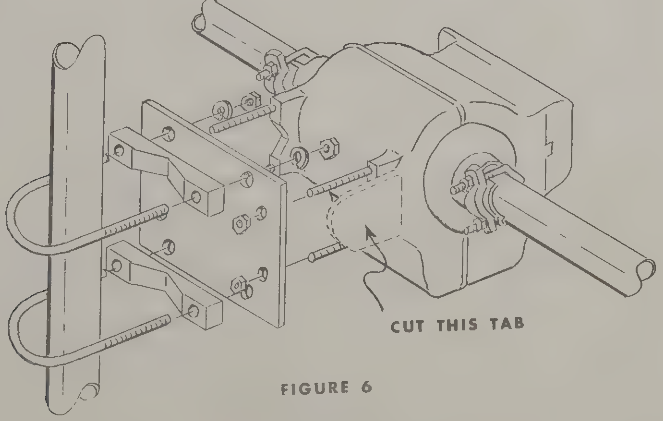
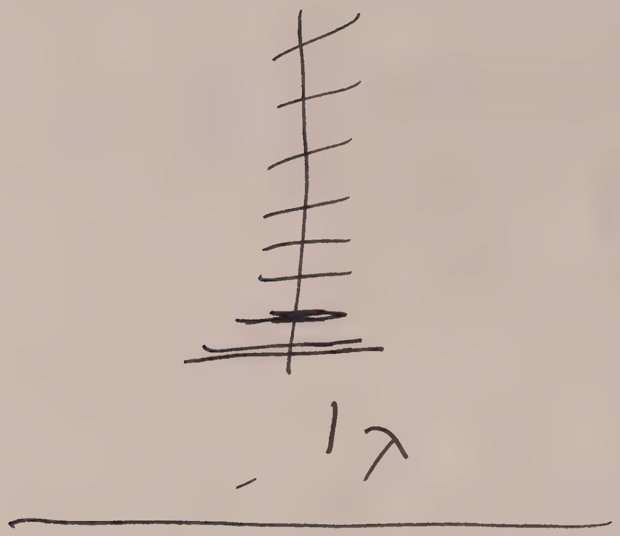
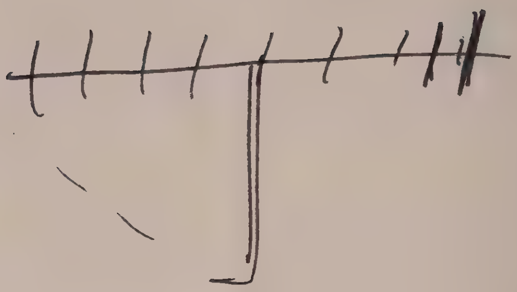


FIGURE 6





SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

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ASSEMBLY INSTRUCTIONS

A449-6, A449-11, A220-11,
A147-4, A147-11, A147-22

A147-VPK, A14-VPK,
A220-VPK, A449-VPK

INSTALLATION SUGGESTIONS

Your Cush Craft VHF/UHF beam is designed and manufactured to give top performance and trouble free service. The antenna will perform as specified, if the instructions and suggestions are followed, and if care is used in assembly and installation.

MASTING: The mast mount brackets on the A147-11, A220-11, and A449-11 will take up to a 1-1/2" O.D. mast. A 1-1/4" O. D. television type tubing is satisfactory for any of the single beams. The A147-22 Power Pack may be mounted on a mast of up to 2" O.D. The A147-4 and A449-6 have extra-length booms for mast or tower side mounting.

MOUNTING: When mounting the beams on the same mast with other VHF/UHF antennas, they should be mounted at least 1/2 wave length (of the lower frequency) away from the other antennas. The beams may be mounted within 4' of 6 meter or HF antennas. Generally, it is best to mount these beams above lower frequency antennas.

ROTATOR: A good quality television antenna rotator will easily handle any of these antennas.

LOCATION: This is very important. Surrounding objects such as trees, power lines, other antennas, etc., will seriously reduce efficiency. To minimize the effects of surrounding objects, mount the antenna as high and in the clear as possible. If metal guy wires are used, they should be broken with strain insulators.

PARTS PACKAGE

PART NO.	DESCRIPTION	QUANTITY					
		A449-6	A449-11	A220-11	A147-4	A147-11	A147-22
1	2" U-bolts	-	-	-	-	-	2
2	1-5/8" U-bolts	-	-	-	-	-	2
3	1-1/2" U-bolts	-	-	-	-	4	8
4	1-1/2" U-bolt brackets	-	1	1	-	-	-
5	5/16" lock washers	2	-	-	2	-	8
6	5/16" hex nuts	2	-	-	2	-	8
12	3/4" plastic caps	-	-	-	2	-	-
14	1-1/2" U-bolt backing plate	-	1	1	-	-	-
15	1/4" flat steel washers	2	-	-	2	8	20
16	1/4" lock washers	-	2	2	-	8	16
17	1/4"-20 hex nuts	-	2	2	-	8	16
21	10-24 x 2" R H machine screws	2	2	10	3	10	20
22	10-24 hex nuts	2	2	10	3	10	20
25	7/8" formed alum. brackets	2	2	10	3	10	20
28	aluminum half washers	2	2	10	3	10	20
29	#10 internal-tooth lock washers	2	2	10	3	10	20
31	2"x4" U-bolts	1	-	-	1	-	-
32	3-1/2" U-bolt brackets	1	-	-	1	-	-
33	3-1/2" U-bolt backing plates	1	-	-	1	-	-
38	1" plastic caps	-	2	1	-	-	-
39	3/8" aluminum spacers	-	-	-	-	4	8
46	1-1/2" plastic caps	-	-	-	-	-	2
53	1/2" plastic caps	2	2	2	-	2	4
61	7/8" plastic caps	2	-	1	2	2	4
78	1-1/2"x 3-1/2" U-bolts	-	1	1	-	-	-
G-10	1" telescope clamps	-	-	1	-	2	4

PARTS LIST

DESCRIPTION	QUANTITY A449-6	 A449-11	 A220-11	 A147-4	 A147-11	 A147-22
7/8"x 44" boom	-	-	-	1	-	-
7/8"x 50" boom sections	-	-	-	-	2	4
1"x 48" boom sections	-	-	1	-	1	2
7/8"x 35" boom	1	-	-	-	-	-
1"x 53" boom	-	1	-	-	-	-
7/8"x 56" boom sections	-	-	1	-	-	-
1-1/2"x 41" boom sections	-	-	-	-	-	2
1-5/8"x 6" center splice	-	-	-	-	-	1
4"x 6" formed aluminum mast bracket	-	-	-	-	1	1
Coax harness assembly	-	-	-	-	-	1

ELEMENTS		LENGTH A449-6	 A449-11	 A220-11	 A147-4	 A147-11	 A147-22
#1	Reflector	13-1/4"	13"	26-1/4"	39-3/4"	40"	40"
#2	Dipole	12-7/16"	12-3/8"	24-15/16"	38"	37-7/8"	37-7/8"
#3	Director	11-7/8"	11-3/4"	23-3/4"	36"	36"	36"
#4	Director	11-13/16"	11-9/16"	23-1/2"	35-3/4"	35-7/8"	35-7/8"
#5	Director	11-3/4"	11-1/2"	23-1/4"	-------	35-3/4"	35-3/4"
#6	Director	11-11/16"	11-7/16"	23"	-------	35-5/8"	35-5/8"
#7	Director	---------	11-3/8"	22-3/4"	-------	35-1/2"	35-1/2"
#8	Director	---------	11-5/16"	22-1/2"	-------	35-3/8"	35-3/8"
#9	Director	---------	11-1/4"	22-1/4"	-------	35-1/4"	35-1/4"
#10	Director	---------	11-3/16"	22"	-------	35-1/8"	35-1/8"
#11	Director	---------	11-1/8"	21-3/4"	-------	35"	35"

All antennas are supplied with one of each size element, except the A147-22 Power Pack has two of each size element. Cutting tolerance is 1/16" for all elements.

ASSEMBLY INSTRUCTIONS

BOOM ASSEMBLY, A147-11 and A220-11: Slide the 7/8" section(s) into the 1" center section, as far as the single black line. To align the boom sections, insert a 2" bolt through one hole in each section, and sight along the boom. Tighten the sections securely with the 1" telescope clamp(s).

ELEMENT ASSEMBLY: The elements for the A147-11, A220-11 and A147-4 (not including the dipole) are taped in one bundle. They are progressively shorter to improve bandwidth. For the A147-4 and A449-6, mount the reflector (longest element) at the U-bolt end of the boom. The A147-11 reflector may be mounted at either end of the boom. For the A220-11, mount the reflector at the end of the 1" boom section. Mount the dipole next, then each progressively shorter director, up to the front director (shortest element), figure 1. All but the two end elements and dipole are preassembled on the booms of the A449-11 and A449-6. Mount them in the proper order as outlined above. Align all elements and tighten securely. Press the plastic caps onto the dipole and boom ends.

MAST MOUNT: The A147-4 and A449-6 use a single U-bolt and bracket assembly, figure 2. The A449-11 and A220-11 use a single U-bolt and bracket assembly, figure 3. The A147-11 uses a 4"x6" plate mounted between the number 5 and 6 elements, figure 4. All of the antennas may be mounted for horizontal or vertical polarization. For vertical polarization, mount them with the Reddi Match rods pointing up. Keep the mast mount bracket on the opposite side of the boom from the elements. This will help to minimize pattern distortion from metallic masts.

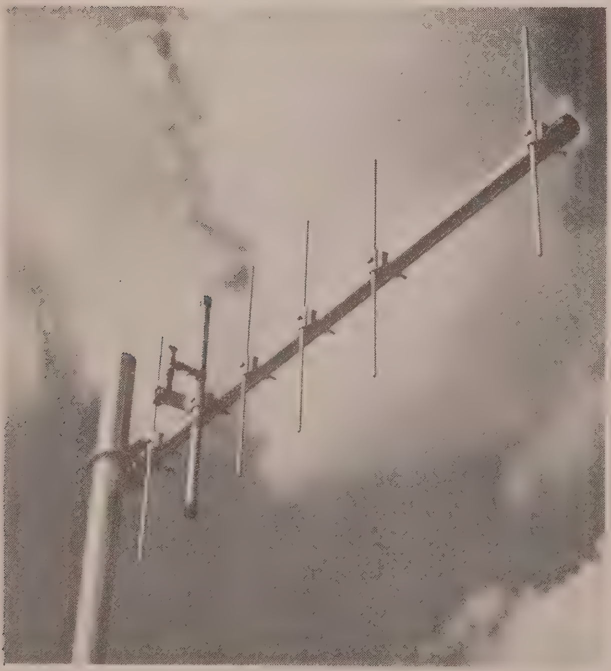
FEED LINE: Attach a standard PL-259 coax fitting to your 52-ohm feed cable, and connect it to the coax fitting on the Reddi Match, figure 5.

TUNING: The Reddi Match is set at the factory for 52-ohm and center band operation. For best results, it should be individually tuned at your site, by using a good quality standing wave ratio bridge. It is not necessary to cut your feed line or prune it to a particular length; any length feed cable may be used with the beams. However, the cable should be as short as possible to reduce feed line losses.

(1.) Insert the SWR bridge in the line between the transmitter and the antenna. For tuning, keep the bridge as close to the antenna as possible, to reduce possible false readings from the cable. Set the transmitter to your center operating frequency.

(2.) Adjust the bridge for maximum forward power. Check the standing wave ratio or reflected power with the bridge in the reverse position. Move away from the antenna when making measurements. If the SWR is high, loosen the tuning strap and adjust it slightly in either direction. If the SWR has increased, move the strap back to its original position and adjust in the opposite direction. If the SWR has dropped, repeat the adjustment procedure until there is little or no reflected power indicated on the bridge. Tighten the tuning strap securely.

(3.) When the antenna is completely assembled and tuned, tighten the feed line connections, tape them, and coat with a clear acrylic spray or equal. Run the coaxial feed line along the boom and down the mast. Use electrical tape to hold it in position.



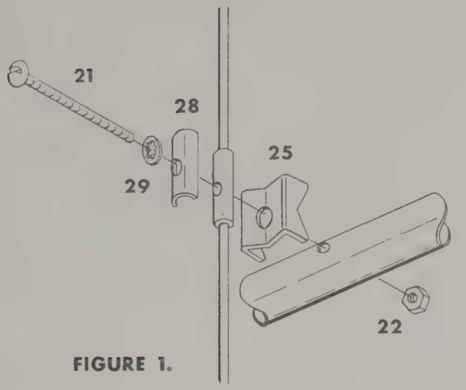


FIGURE 1.

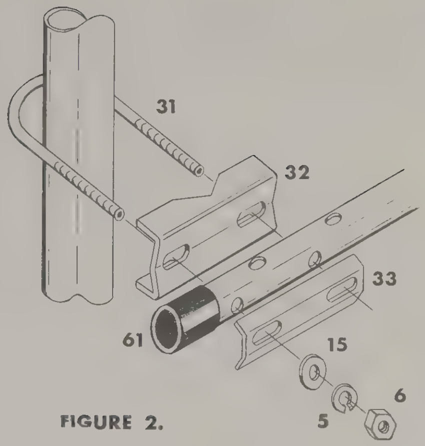


FIGURE 2.

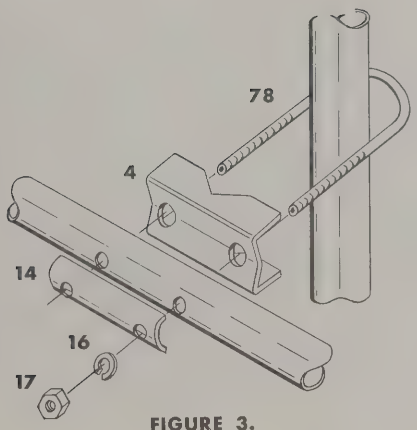


FIGURE 3.

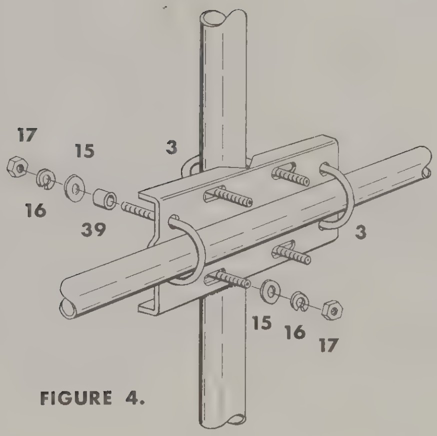


FIGURE 4.

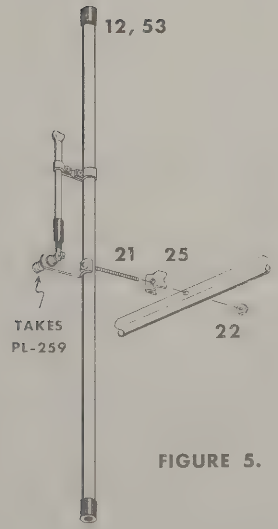


FIGURE 5.

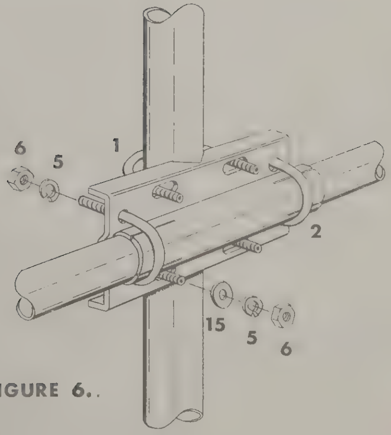


FIGURE 6.

STACKING KITS

PARTS LIST

DESCRIPTION	QUANTITY A147-VPK	A14-VPK	A220-VPK	A449-VPK
1-1/2"x 41" boom sections	2	-	-	-
1-1/2"x 27" boom sections	-	2	2	-
1-1/4"x 33" boom	-	-	-	1
1-5/8"x 6" center splice	1	1	1	-
4"x 6" formed aluminum mast bracket	1	1	1	-
Coax harness assembly	1	1	1	1

PARTS PACKAGE

PART NO.	DESCRIPTION	QUANTITY A147-VPK	A14-VPK	A220-VPK	A449-VPK
1	2" U-bolts	2	2	2	-
2	1-5/8" U-bolts	2	2	2	-
5	5/16" lock washers	8	8	8	2
6	5/16" hex nuts	8	8	8	2
13	1-1/4" plastic caps	-	-	-	2
15	1/4" flat steel washers	4	4	4	2
31	2"x 4" U-bolts	-	-	-	1
32	3-1/2" U-bolt bracket	-	-	-	1
33	3-1/2" U-bolt backing plate	-	-	-	1
46	1-1/2" plastic caps	2	2	2	-

STACKED ARRAYS: A147-22, A147-VPK, A14-VPK, A220-VPK, A449-VPK.
The following instructions apply to the A147-22 Power Pack and all of the VPK stacking kits. Refer to the single beam instructions for assembly and tuning of the individual antennas.

To assemble the A147-22, A147-VPK, A14-VPK and A220-VPK mounting booms, slide the 1-1/2" sections into the 1-5/8" center splice, as far as the single black line. The 4"x 6" mounting plate and U-bolts clamp the sections together, figure 6. The A449-VPK mounting boom uses a single U-bolt and bracket assembly in the center, figure 2.

Mount the antennas on the ends of the support boom, using Chart 1, Dimension A, for the proper spacing, which is measured center-to-center on the antenna booms. For mechanical balance, it is best to keep the antenna booms below the support boom. The Reddi Match rods should be on the same side of the antenna booms, and pointing up. Press the plastic caps onto the boom ends.

Attach an end of the stacking harness to each Reddi Match. Run the cable along the boom. Use electrical tape to hold it in position. Any excess cable in the harness should be coiled equally on each side of the center T-fitting. Connect your 52-ohm feed cable to the T-fitting.

To tune the array, it is only necessary to adjust one antenna Reddi Match, using the same procedure as for the single antenna. When the array is assembled and tuned, tighten all connections. Cable connectors may be taped, and covered with a clear acrylic spray or equal.

Two arrays can be mounted in a quad configuration by using the appropriate coaxial harness between the dual arrays, Chart 1. Use Dimension A for the vertical and horizontal spacing dimensions, which are measured center-to-center on the antenna booms.

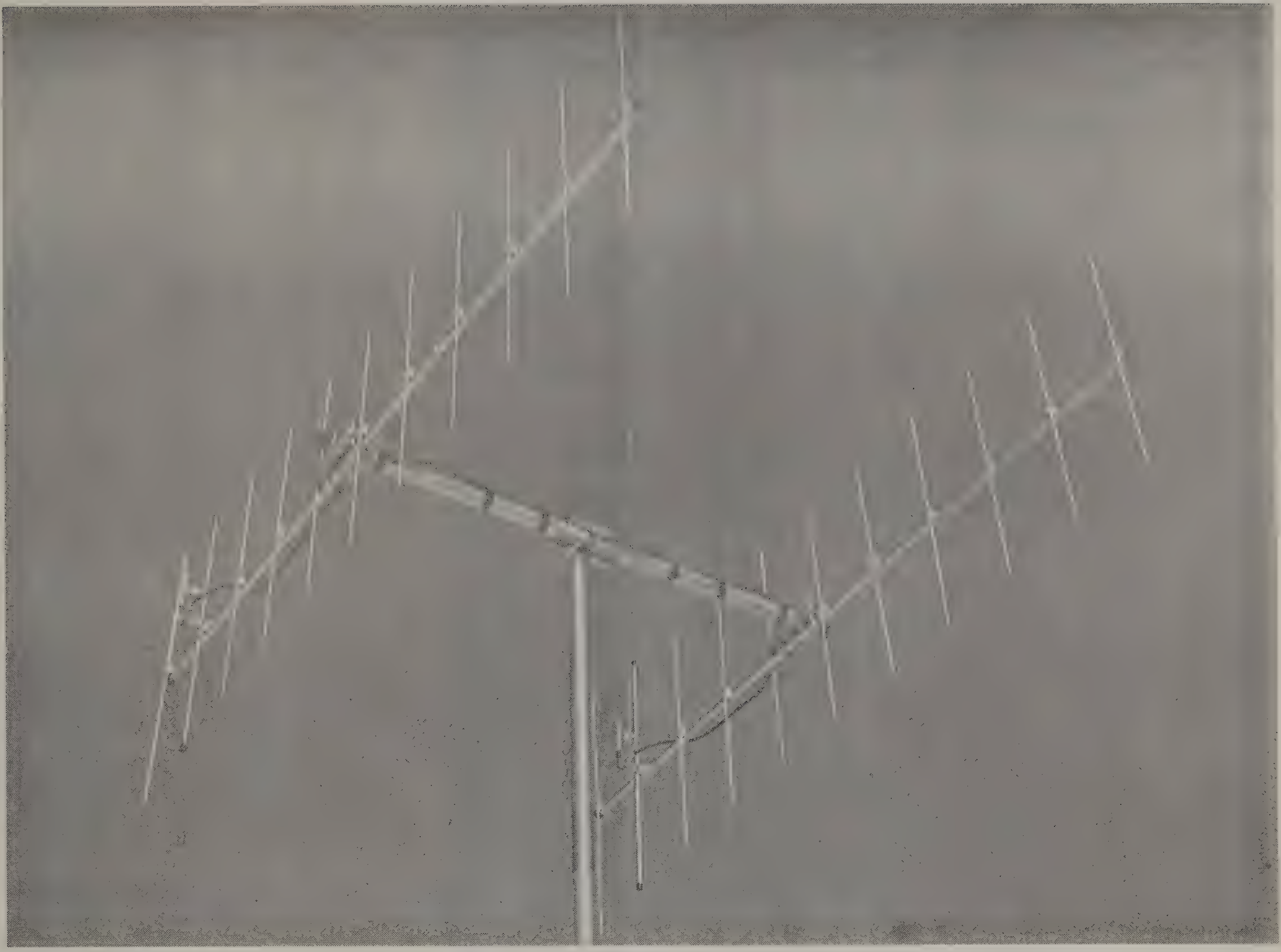


CHART 1.

ANTENNA MODEL NO.	DUAL STACKING KIT	HARNESS NO.	DIMENSION A
A147-11	A147-VPK	A147-SK	76"
A147-22	———	A147-SK	76"
A147-4	A14-VPK	A14-SK	50"
A220-11	A220-VPK	A220-SK	50"
A449-11	A449-VPK	A449-SK	25"
A449-6	A449-VPK	A449-SK	25"

WARNING

THIS ANTENNA IS AN ELECTRICAL CONDUCTOR. CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY.

DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS.

THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION- REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL.

CONSULT THE NATIONAL ELECTRICAL CODE FOR FURTHER DETAILS.

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ASSEMBLY INSTRUCTIONS

A147-4, A147-11, A147-22,
A220-7, A220-11, A449-6,
A449-11
A14-VPK, A147-VPK,
A220-VPK, A449-VPK

SPECIFICATIONS

MODEL	A147-4	A147-11	A147-22	A220-7	A220-11	A449-6	A449-11
Frequency, MHz	146-148	146-148	146-148	220-225	220-225	440-450	440-450
2:1 VSWR bandwidth	4 MHz	3 MHz	3 MHz	5 MHz	5 MHz	10 MHz	10 MHz
Gain	9.0 dBd	11.3 dBd	14.2 dBd	10.5 dBd	11.3 dBd	10.0 dBd	11.3 dBd
Front-to-back ratio	18 dB	20 dB	20 dB	20 dB	20 dB	18 dB	20 dB
3-dB beamwidth	66°	48°	42°	57°	48°	60°	48°
Boom length	44" (1.1m)	144" (3.6m)	144" (3.6m)	69" (1.7m)	102" (2.6m)	35" (89cm)	60" (1.5cm)
Longest element	40" (1.0m)	40" (1.0m)	40" (1.0m)	27" (66cm)	26" (66cm)	13" (33cm)	13" (33cm)
Turning radius	44" (1.1m)	72" (1.8m)	85" (2.2m)	69" (1.7m)	51" (1.3m)	18" (46cm)	60" (1.5m)
Wind area	0.43 ft^2 (.04m^2)	1.21 ft^2 (.11m^2)	1.42 ft^2 (1.13m^2)	0.48 ft^2 (.04m^2)	0.50 ft^2 (.05m^2)	0.30 ft^2 (.03m^2)	0.39 ft^2 (0.4m^2)
Weight	3 lb (1.4kg)	6 lb (2.7kg)	15 lb (6.7kg)	2 lb (.9kg)	5 lb (2.3kg)	3 lb (1.4kg)	4 lb (1.8kg)
Maximum mast OD	2" (5.0cm)	1-1/2" (3.8cm)	2" (5.0cm)	2" (5.0cm)	1-1/2" (3.8cm)	2" (5.0cm)	1-1/2" (3.8cm)

PARTS PACKAGE

PART NO.	DESCRIPTION	A147-4	A147-11	A147-22	A220-7	A220-11	A449-6	A449-11
1	2" (5.0cm) I.D. U-bolt			2				
2	1-5/8" (4.1cm) I.D. U-bolt			2				
3	1 1/2" (3.8cm) I.D. U-bolt		4	8				
4	Bracket for 1 1/2" (3.8cm) U-bolt					1		1
5	5/16" (.8cm) I.D. lock washer	2		8	2		2	
6	5/16" (.8cm) I.D. hex nut	2		8	2		2	
14	Backing plate for 1 1/2" (3.8cm) U-bolt					1		1
15	5/16" (.8cm) I.D. flat steel washer	2	8	20	2		2	
16	1/4"-20 lock washer		8	16		2		2
17	1/4"-20 hex nut		8	16		2		
21	#10-24 x 2" (5.0cm) machine screw	3	10	20	6	10	2	2
22	#10-24 hex nut	3	10	20	6	10	2	2
25	7/8" (2.2cm) formed aluminum bracket	3	10	20	6	10	2	2
28	Aluminum half washer	3	10	20	6	10	2	2
29	#10 internal-tooth lock washer	3	10	20	6	10	2	2
31	2" (5.0cm) I.D. x 4" (10.1cm) U-bolt	1			1		1	
32	Bracket for 2" (5.0cm) x 4" (10.1cm) U-bolt	1			1		1	
33	Bracking plate for 2" (5.0cm) x 4" (10.1cm) U-bolt	1			1		1	
38	1" (2.5cm) plastic cap				1	1		2
39	3/8" (.9cm) I.D. aluminum spacer		4	8				
46	1 1/2" (3.8cm) plastic cap			2				
53	1/2" (1.2cm) plastic cap		2	4	2	2	2	2
61	7/8" (2.2cm) plastic cap	2	2	4	1	1	2	
78	1 1/2" (3.8cm) I.D. x 3 1/2" (8.8cm) U-bolt					1		1
G10	1" (2.5cm) telescope clamp		2	4	1	1		

PARTS LIST

DESCRIPTION	QUANTITY						
	A147-4	A147-11	A147-22	A220-7	A220-11	A449-6	A449-11
7/8" (2.2cm) x 24" (61.0cm) boom section				1			
7/8" (2.2cm) x 35" (88.9cm) boom						1	
7/8" (2.2cm) x 44" (111.8cm) boom	1						
7/8" (2.2cm) x 50" (127.0cm) boom section		2	4				
7/8" (2.2cm) x 56" (134.6cm) boom section					1		
1" (2.5cm) x 48" (121.9cm) boom section		1	2	1	1		
1" (2.5cm) x 53" (134.6cm) boom							1
1-5/8" (4.1cm) x 6" (15.2cm) center splice			1				
1-1/2" (3.8cm) x 41" (104.1cm) boom section			2				
4" (10.2cm) x 6" (15.2cm) formed alum. mast plate		1	3				

ELEMENTS		LENGTH						
		A147-4	A147-11	A147-22	A220-7	A220-11	A449-6	A449-11
#1	Reflector	39-3/4" (100cm)	40" (101.6cm)	40" (101.6cm)	26-1/4" (66,7cm)	26-1/4" (66.7cm)	13-1/8" (33.3cm)	13-1/8" (33.3cm)
#2	Dipole	38" (96.5cm)	37-7/8" (96.2cm)	37-7/8" (96.2cm)	24-15/16" (63.3cm)	24-15/16" (63.3cm)	12-3/8" (31.4cm)	12-3/8" (31.4cm)
#3	Director	36" (91.4cm)	36" (91.4cm)	36" (91.4cm)	23-3/4" (60.3cm)	23-3/4" (60.3cm)	11-3/4" (29.8cm)	11-3/4 (29.8cm)
#4	Director	35-3/4" (90.8cm)	35-7/8" (91.1cm)	35-7/8" (91.1cm)	23-1/2" (59.7cm)	23-1/2" (59.7cm)	11-5/8" (29.5cm)	11-5/8" (29.5cm)
#5	Director		35-3/4" (90.8cm)	35-3/4" (90.8cm)	23-1/4" (59.1cm)	23-1/4" (59.1cm)	11-1/2" (29.2cm)	11-1/2" (29.2cm)
#6	Director		35-5/8" (90.5cm)	35-5/8" (90.5cm)	23" (58.4cm)	23" (58.4cm)	11-3/8" (28.9cm)	11-3/8" (28.9cm)
#7	Director		35-1/2" (90.1cm)	35-1/2" (90.1cm)	22-3/4" (57.8cm)	22-3/4" (57.8cm)		11-1/4" (28.5cm)
#8	Director		35-3/8" (89.9cm)	35-3/8" (89.9cm)		22-1/2" (57.2cm)		11-1/8" (28.3cm)
#9	Director		35-1/4" (89.5cm)	35-1/4" (89.5cm)		22-1/4" (56.5cm)		11" (27.9cm)
#10	Director		35-1/8" (89.2cm)	35-1/8" (89.2cm)		22" (55.9cm)		10-7/8" (27.6cm)
#11	Director		35" (88.9cm)	35" (88.9cm)		21-3/4" (55.2cm)		10-3/4" (27.3cm)

All antennas are supplied with one of each size element, except the A147-22 Power Pack has two of each size element. Cutting tolerance is 1/16" (.6mm) for all elements.

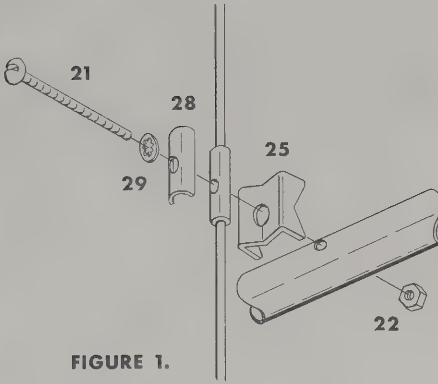


FIGURE 1.

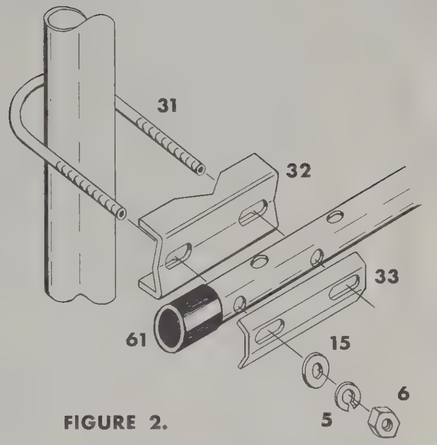


FIGURE 2.

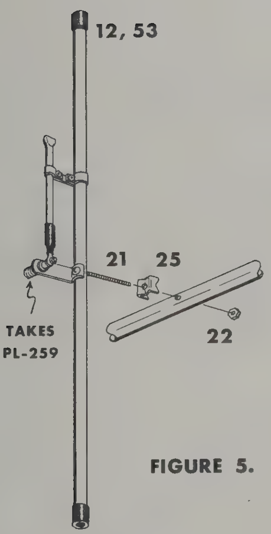


FIGURE 5.

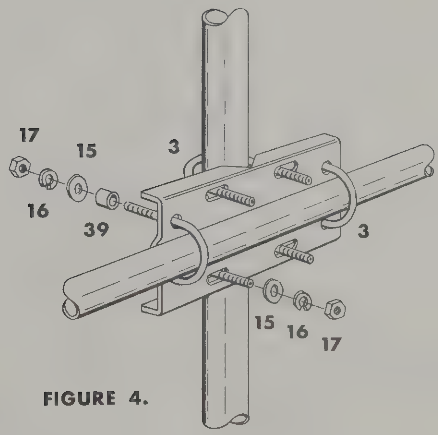


FIGURE 4.

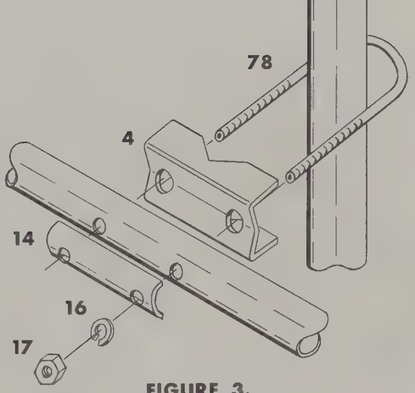


FIGURE 3.

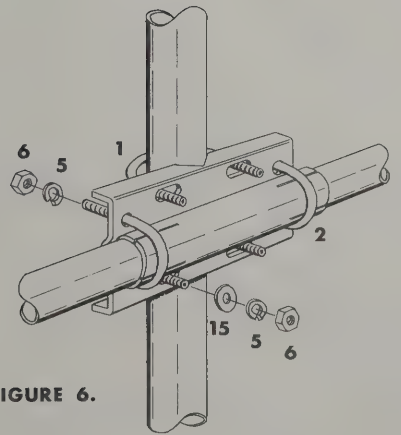
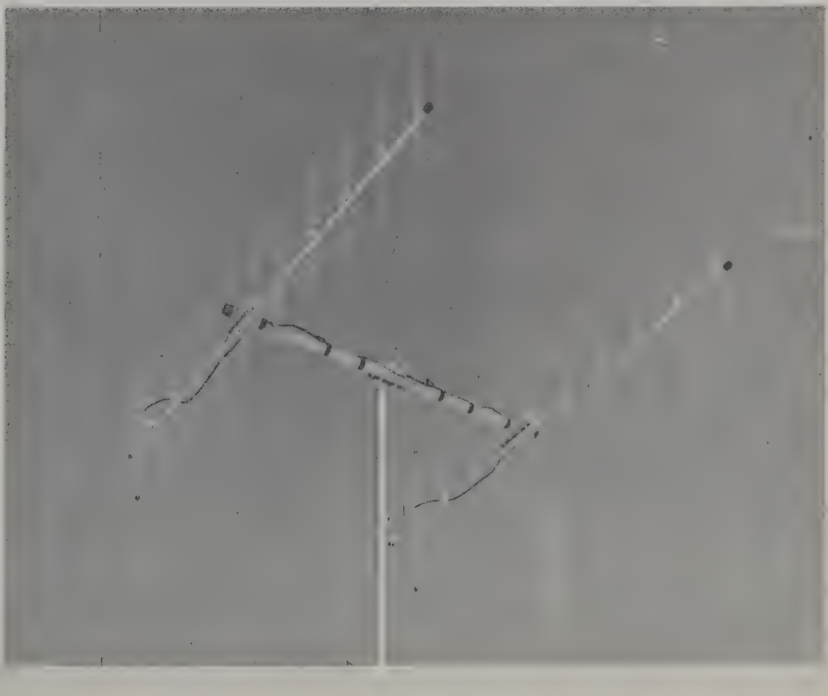


FIGURE 6.



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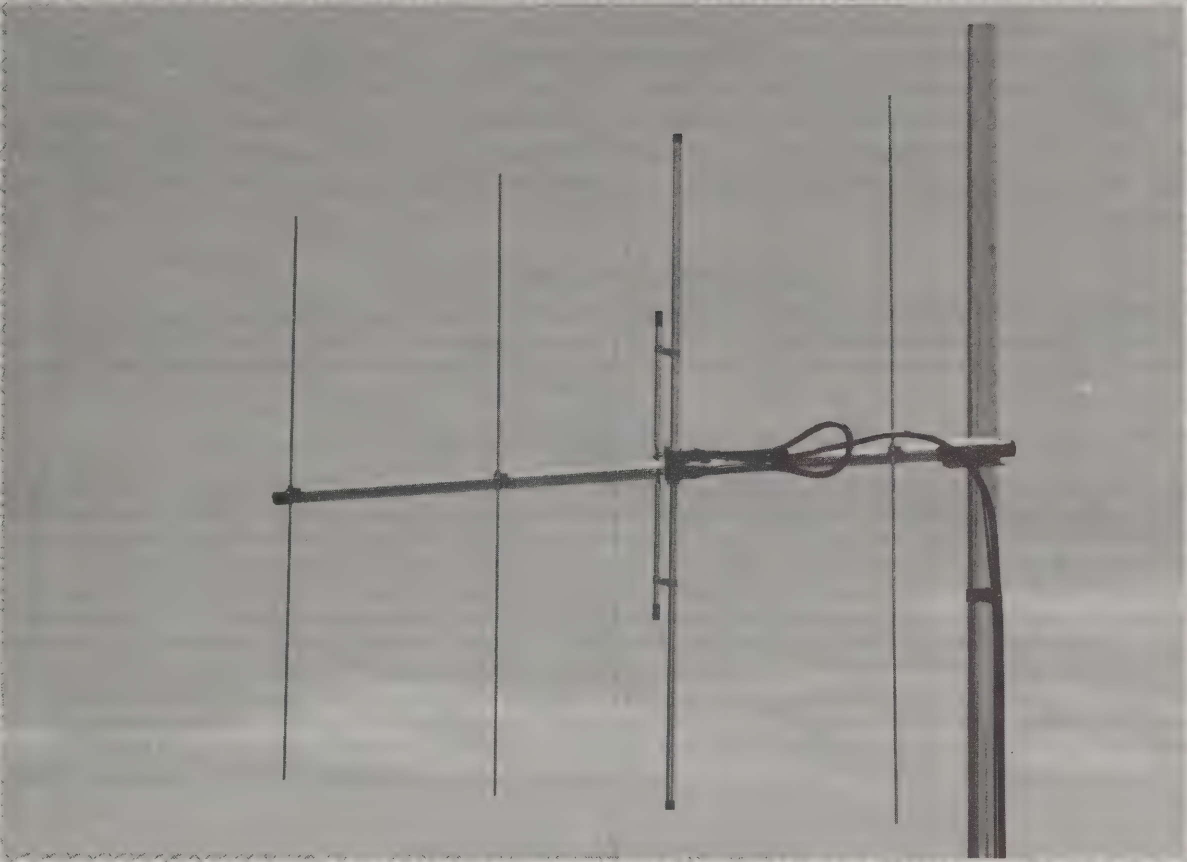
ASSEMBLY & INSTALLATION INSTRUCTIONS



124WB BOOMER

4 ELEMENT BROADBAND 2 METER YAGI

cushcraft
CORPORATION
THE ANTENNA COMPANY

951338(8/86)

INSTALLATION SUGGESTIONS

Your Cushcraft VHF beam is designed and manufactured to give top performance and trouble free service. The antenna will perform as specified if the instructions and suggestions are followed, and if care is used in assembly and installation.

MAST: The antenna may be mounted on any mast diameter up to 2″ (5.1cm)

MOUNTING: When installing more than one beam on the same mast, the spacing between adjacent antennas should be one half wavelength of the lower frequency. Generally, it is best to locate the lowest frequency antenna at the bottom of the mast.

LOCATION: of the antenna is very important. Surrounding objects such as trees, power lines, other antennas, etc. will seriously reduce efficiency. To minimize the effects of surrounding objects, mount the antenna as high and in the clear as possible. If metal guy wires are used, they should be broken with strain insulators.

WARNING: THIS ANTENNA IS AN ELECTRICAL CONDUCTOR. CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION-REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. FOLLOW THE GUIDELINES FOR ANTENNA INSTALLATIONS RECOMMENDED BY THE U.S. CONSUMER PRODUCT SAFETY COMMISSION AND LISTED IN THE PAMPHLET THAT CAME WITH YOUR ANTENNA.

ASSEMBLY INSTRUCTIONS

ELEMENT ASSEMBLY: The elements except for the dipole are taped together. They are progressively shorter from reflector to directors. Using fig. 1 mount the longest element 7″ (17.8cm) from the u-bolt end of the boom. Next using fig. 2 mount the dipole. Now mount the longer of the remaining elements next to the dipole and then mount the remaining element at the end of the boom.

MAST MOUNT: Refer to figure 3 and mount the u-bolt to the boom and mast.

TUNING: The T match should be set at 6⅜″ (16.19cm) for 50-ohms and full 2 meter band operation. If retuning becomes necessary use a good quality standing wave ratio bridge. It is not necessary to cut your feedline or prune it to a particular length; any length cable may be used with the beam. However, the cable should be as short as possible to reduce feedline losses. Your cable should be equipped with a standard PL-259 coaxial fitting, to connect to the T match connector, figure 2.

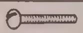
Tune the antenna at your center frequency; using a 50-ohm feedline from your transmitter, and a VSWR bridge. Connect the VSWR bridge to the antenna with a short length 50 ohm coaxial cable. Slide the T match tuning straps by ⅛ inch increments, keeping the spacing of the straps the same each side of center of the dipole, until you obtain the lowest VSWR reading. Move away from the antenna each time you check the VSWR reading. Repeat this procedure until the VSWR reading is at the lowest level. Disconnect the cable and bridge, and tighten the tuning strap securely. Use the vinyl boot on the coaxial cable to the beam to insure a weather proof connection. Coat the outside of the aluminum connector threads and the PL-259s with silicone grease provided. Do not coat the connector center pins or sockets with silicone. Slide the vinyl boots over the connectors and against the plate for a good weather tight connection, figure 2B. Run the coaxial feedline along the boom and down the mast using electrical tape to hold it in position.

STACKING FOR MORE GAIN

Two 124WB beams may be stacked for 3 dB gain increase using the PD2 power divider and equal lengths of 50 ohm coaxial cable to each antenna.

SPACING: E plane 72″ (182.9cm), H plane 56″ (142.2cm). See figure 5, on back page.

ELEMENT ASSEMBLY

P/N	KEY	DISPLAY	DESC.	SIZE	QTY
010010	10		Lock Washer	#8	6
010011	11		Hex Nut	#8-32	3
010120	120		Machine Screw	#8-32 × 2″ (5.08cm)	3
190026	26		Alum Half Washer	1″ (2.54cm)	3
190028	28		Aluminum Bracket	⅞″ (2.22cm)	3

ELEMENT CHART

ELEMENT	LENGTH
E1	40¾″ (103.5cm)
E2	38⅝″ (98.11cm)
E3	36 11/16″ (93.19cm)
E4	34″ (86.36cm)

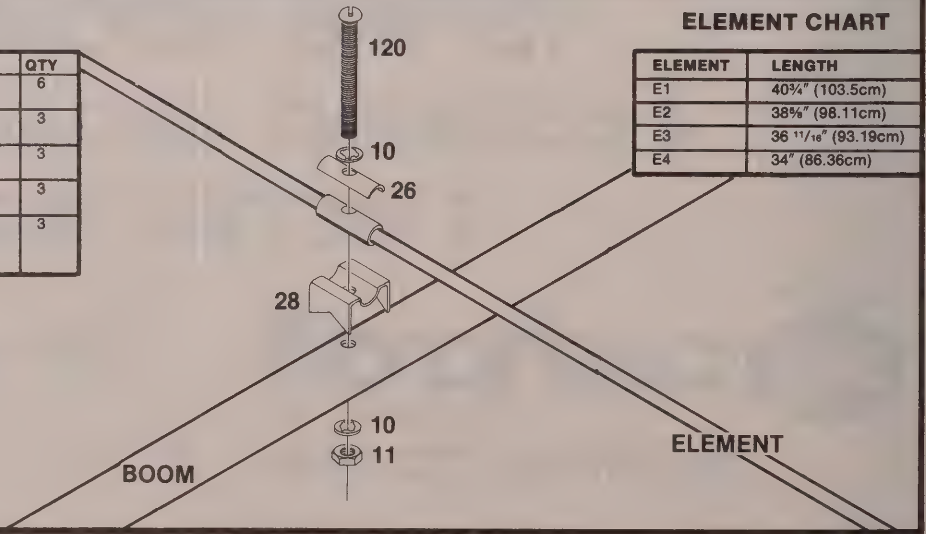
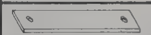
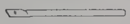
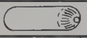


FIGURE 1

DRIVEN ELEMENT ASSEMBLY

P/N	KEY	DISPLAY	DESC.	SIZE	QTY
010010	10		Lock Washer	#8	9
010011	11		Hex Nut	#8-32	8
010120	120		Machine Screw	#8-32 × 2″ (5.08cm)	1
010079	79		Machine Screw	#8-32 × ½″ (1.27cm)	4
190026	26		Aluminum Bracket	⅞″ (2.22cm)	1
200125	125		Tuning Strap	⅜″ (.95cm)	2
190124	124		Connector Strap	1 ⁷/₁₆″ (3.65cm)	1
050077	77		Plastic Cap	⅜″ (.95cm)	2
050053	53		Plastic Cap	½″ (1.27cm)	2
	BN		Coaxial Balun	RG-11, 24″ (60.96cm)	1
	DC		Connector Bracket	2 × 2¼″ (5.08 × 5.72cm)	1
	ET		T-Match Tube	⅜″ × 8½″ (.95 × 21.6cm)	2
	ED		Driven Element	½″ × 38⅝″ (1.27 × 98.11cm)	1
050115	115		Vinyl Boot		1
240116	116		Silicone Package		2
290326	326		Danger Label		1

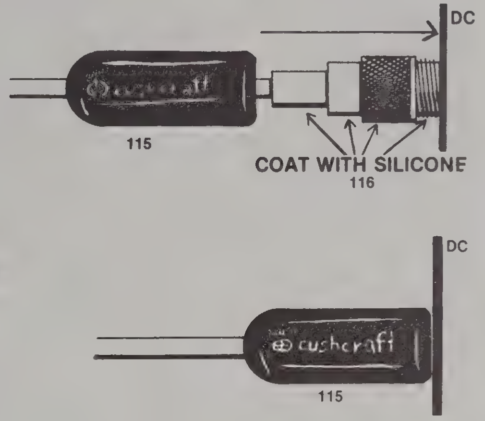


FIGURE 2B

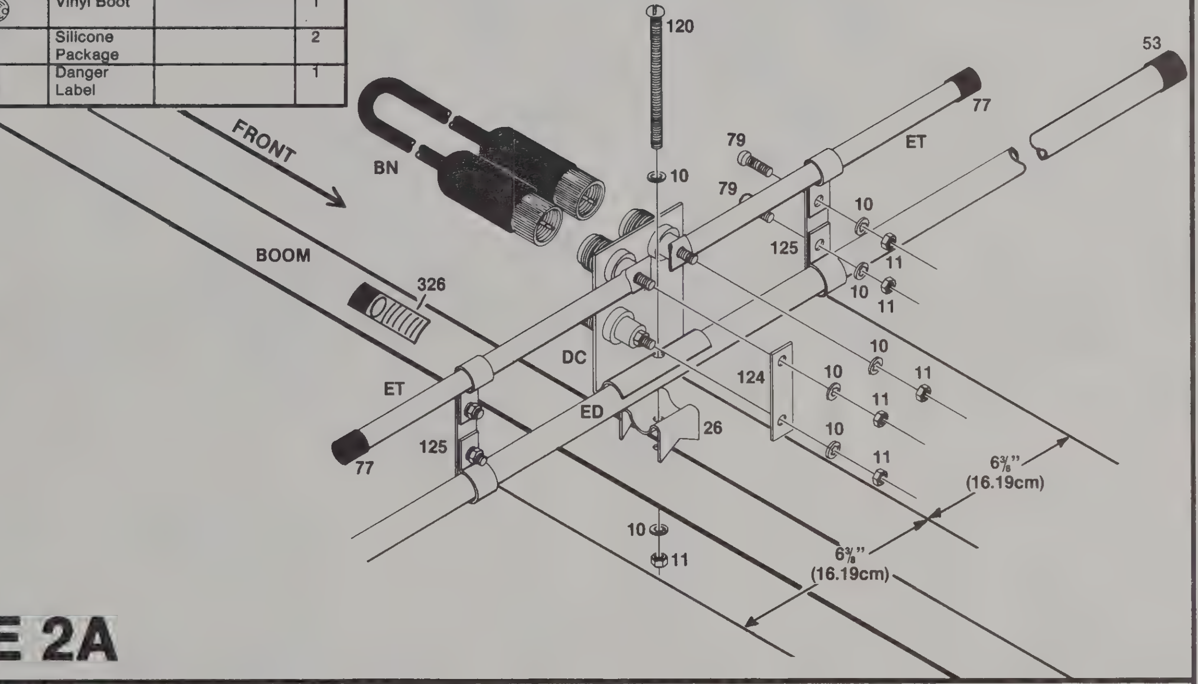


FIGURE 2A

MOUNTING ASSEMBLY

P/N	KEY	DISPLAY	DESC.	SIZE	QTY
	BA		Boom	⅞″ × 48″ (2.22 × 121.92cm)	1
010118	118		Hex Nut	⁵/₁₆″ (0.79cm)	2
010119	119		Lock Washer	⁵/₁₆″ (0.79cm)	2
010405	405		U-Bolt	4¼″ × 2⅜″ (10.8 × 6.03cm)	1
190032	32		U-Bolt Bracket	3½″ (8.89cm)	1
190033	33		U-Bolt Backing Plate	3½″ (8.89cm)	1
050061	61		Plastic Cap	⅞″ (2.22cm)	2

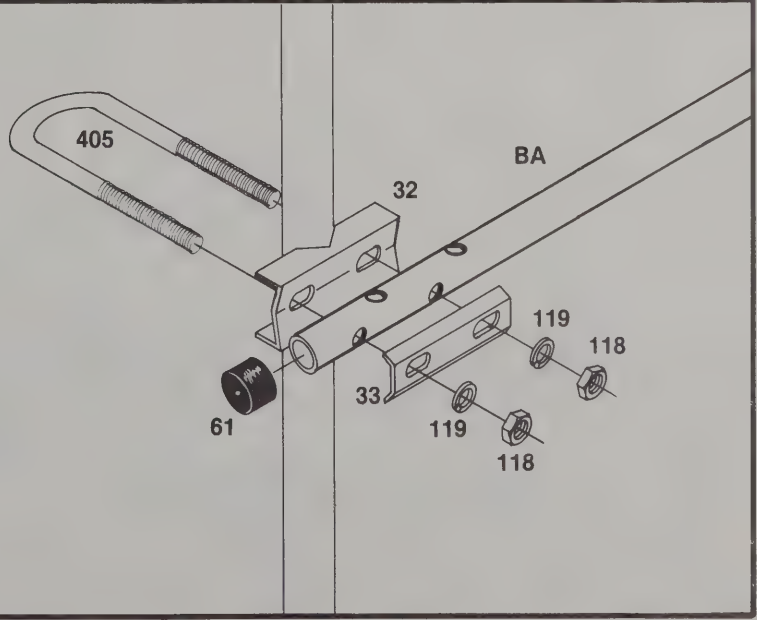


FIGURE 3

LIMITED WARRANTY

CUSHCRAFT CORPORATION, P.O. BOX 4680, MANCHESTER, NEW HAMPSHIRE 03108, WARRANTS TO THE ORGINAL CONSUMER PURCHASER FOR ONE YEAR FROM DATE OF PURCHASE THAT EACH CUSHCRAFT ANTENNA IS FREE OF DEFECTS IN MATERIAL OR WORKMANSHIP. IF, IN THE JUDGEMENT OF CUSHCRAFT, ANY SUCH ANTENNA IS DEFECTIVE, THEN CUSHCRAFT CORPORATION WILL, AT ITS OPTION, REPAIR OR REPLACE THE ANTENNA AT ITS EXPENSE WITHIN THIRTY DAYS OF THE DATE THE ANTENNA IS RETURNED (AT PURCHASER'S EXPENSE) TO CUSHCRAFT OR ONE OF ITS AUTHORIZED REPRESENTATIVES. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESSED WARRANTIES. ANY IMPLIED WARRANTY IS LIMITED IN DURATION TO ONE YEAR. CUSHCRAFT CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM A DEFECT. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR EXCLUSIONS OR LIMITATIONS OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION AND EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. THIS WARRANTY DOES NOT EXTEND TO ANY PRODUCTS WHICH HAVE BEEN SUBJECT TO MISUSE, NEGLECT, ACCIDENT OR IMPROPER INSTALLATION. ANY REPAIRS OR ALTERATIONS OUTSIDE OF THE CUSHCRAFT FACTORY WILL NULLIFY THIS WARRANTY.

SPECIFICATIONS

Frequency Range: MHz	144-148
Forward Gain: dBd	10.2
Number of Elements:	4
F/B Ratio: dB	19
Impedance: OHMS	50
E Plane Beamwidth: Degrees	60
H Plane Beamwidth: Degrees	83
Connector Type:	S0239
1.5:1 VSWR Bandwidth Typical: MHz	5.5
Mounting:	Rear Mount 2″ Max. Dia. Mast Horizontal or Vertical
Wind Area: ft² (m²)	.34 (.032)
Weight Assembled: lbs (kg)	3 (.95)
Hardware:	All Stainless Steel

OVERALL VIEW

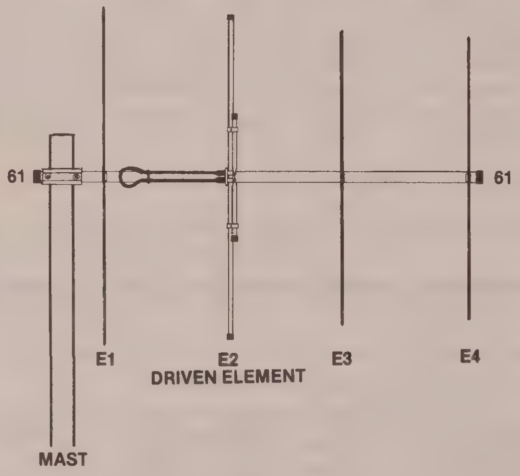
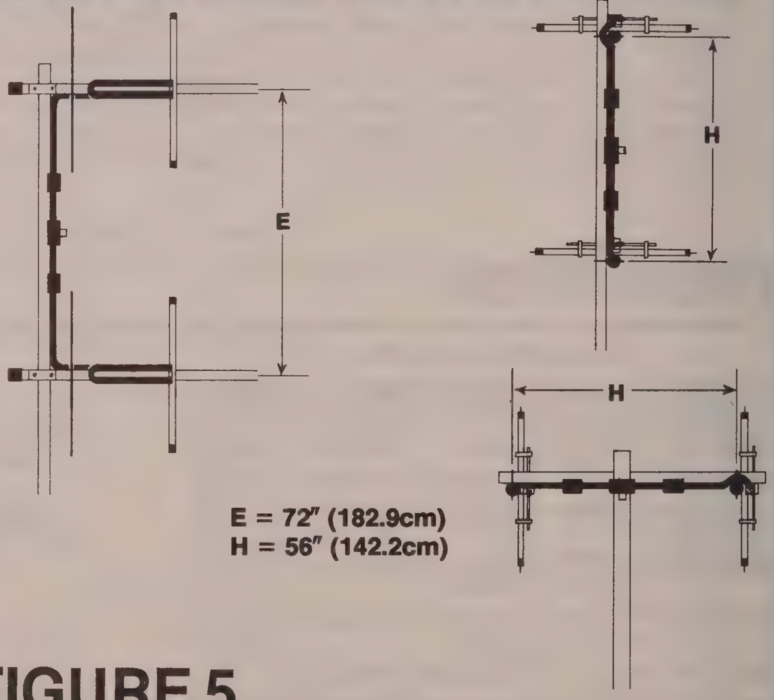


FIGURE 4

STACKING DIMENSIONS



E = 72″ (182.9cm)
H = 56″ (142.2cm)

FIGURE 5

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P.O. BOX 4680, MANCHESTER, N.H. 03108

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

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ASSEMBLY INSTRUCTIONS

A147-4, A147-11, A147-22, A220-7, A220-11, A449-6, A449-11

A14-VPK, A147-VPK, A220-VPK, A449-VPK

951277

SPECIFICATIONS

MODEL	A147-4	A147-11	A147-22	A220-7	A220-11	A449-6	A449-11
Frequency, MHz	146-148	146-148	146-148	220-225	220-225	440-450	440-450
2:1 VSWR bandwidth	4 MHz	3 MHz	3 MHz	5 MHz	5 MHz	10 MHz	10 MHz
Gain	9.0 dBd	11.3 dBd	14.2 dBd	10.5 dBd	11.3 dBd	10.0 dBd	11.3 dBd
Front-to-back ratio	18 dB	20 dB	20 dB	20 dB	20 dB	18 dB	20 dB
3-dB beamwidth	66°	48°	42°	57°	48°	60°	48°
Boom length	44" (1.1m)	144" (3.6m)	144" (3.6m)	69" (1.7m)	102" (2.6m)	35" (89cm)	60" (1.5cm)
Longest element	40" (1.0m)	40" (1.0m)	40" (1.0m)	27" (66cm)	26" (66cm)	13" (33cm)	13" (33cm)
Turning radius	44" (1.1m)	72" (1.8m)	85" (2.2m)	69" (1.7m)	51" (1.3m)	18" (46cm)	60" (1.5m)
Wind area	0.43 ft^2 (.04m^2)	1.21 ft^2 (.11m^2)	1.42 ft^2 (1.13m^2)	0.48 ft^2 (.04m^2)	0.50 ft^2 (.05m^2)	0.30 ft^2 (.03m^2)	0.39 ft^2 (0.4m^2)
Weight	3 lb (1.4kg)	6 lb (2.7kg)	15 lb (6.7kg)	2 lb (.9kg)	5 lb (2.3kg)	3 lb (1.4kg)	4 lb (1.8kg)
Maximum mast OD	2" (5.0cm)	1-1/2" (3.8cm)	2" (5.0cm)	2" (5.0cm)	1-1/2" (3.8cm)	2" (5.0cm)	1-1/2" (3.8cm)

PARTS PACKAGE

PART NO.	DESCRIPTION	A147-4	A147-11	A147-22	A220-7	A220-11	A449-6	A449-11
1	2" (5.0cm) I.D. U-bolt			2				
2	1-5/8" (4.1cm) I.D. U-bolt			2				
3	1 1/2" (3.8cm) I.D. U-bolt		4	8				
4	Bracket for 1 1/2" (3.8cm) U-bolt					1		1
5	5/16" (.8cm) I.D. lock washer	2		8	2		2	
6	5/16" (.8cm) I.D. hex nut	2		8	2		2	
14	Backing plate for 1 1/2" (3.8cm) U-bolt					1		1
15	5/16" (.8cm) I.D. flat steel washer	2	8	20	2		2	
16	1/4"-20 lock washer		8	16		2		2
17	1/4"-20 hex nut		8	16		2		
21	#10-24 x 2" (5.0cm) machine screw	3	10	20	6	10	2	2
22	#10-24 hex nut	3	10	20	6	10	2	2
25	7/8" (2.2cm) formed aluminum bracket	3	10	20	6	10	2	2
28	Aluminum half washer	3	10	20	6	10	2	2
29	#10 internal-tooth lock washer	3	10	20	6	10	2	2
31	2" (5.0cm) I.D. x 4" (10.1cm) U-bolt	1			1		1	
32	Bracket for 2" (5.0cm) x 4" (10.1cm) U-bolt	1			1		1	
33	Bracking plate for 2" (5.0cm) x 4" (10.1cm) U-bolt	1			1		1	
38	1" (2.5cm) plastic cap				1	1		2
39	3/8" (.9cm) I.D. aluminum spacer		4	8				
46	1 1/2" (3.8cm) plastic cap			2				
53	1/2" (1.2cm) plastic cap		2	4	2	2	2	2
61	7/8" (2.2cm) plastic cap	2	2	4	1	1	2	
78	1 1/2" (3.8cm) I.D. x 3 1/2" (8.8cm) U-bolt					1		1
G10	1" (2.5cm) telescope clamp		2	4	1	1		

PARTS LIST

DESCRIPTION	QUANTITY A147-4	A147-11	A147-22	A220-7	A220-11	A449-6	A449-11
7/8" (2.2cm) x 24" (61.0cm) boom section				1			
7/8" (2.2cm) x 35" (88.9cm) boom						1	
7/8" (2.2cm) x 44" (111.8cm) boom	1						
7/8" (2.2cm) x 50" (127.0cm) boom section		2	4				
7/8" (2.2cm) x 56" (134.6cm) boom section					1		
1" (2.5cm) x 48" (121.9cm) boom section		1	2	1	1		
1" (2.5cm) x 53" (134.6cm) boom							1
1-5/8" (4.1cm) x 6" (15.2cm) center splice			1				
1-1/2" (3.8cm) x 41" (104.1cm) boom section			2				
4" (10.2cm) x 6" (15.2cm) formed alum. mast plate		1	3				

	ELEMENTS	LENGTH A147-4	A147-11	A147-22	A220-7	A220-11	A449-6	A449-11
#1	Reflector	39-3/4" (100cm)	40" (101.6cm)	40" (101.6cm)	26-1/4" (66,7cm)	26-1/4" (66.7cm)	13-1/8" (33.3cm)	13-1/8" (33.3cm)
#2	Dipole	38" (96.5cm)	37-7/8" (96.2cm)	37-7/8" (96.2cm)	24-15/16" (63.3cm)	24-15/16" (63.3cm)	12-3/8" (31.4cm)	12-3/8" (31.4cm)
#3	Director	36" (91.4cm)	36" (91.4cm)	36" (91.4cm)	23-3/4" (60.3cm)	23-3/4" (60.3cm)	11-3/4" (29.8cm)	11-3/4 (29.8cm)
#4	Director	35-3/4" (90.8cm)	35-7/8" (91.1cm)	35-7/8" (91.1cm)	23-1/2" (59.7cm)	23-1/2" (59.7cm)	11-5/8" (29.5cm)	11-5/8" (29.5cm)
#5	Director		35-3/4" (90.8cm)	35-3/4" (90.8cm)	23-1/4" (59.1cm)	23-1/4" (59.1cm)	11-1/2" (29.2cm)	11-1/2" (29.2cm)
#6	Director		35-5/8" (90.5cm)	35-5/8" (90.5cm)	23" (58.4cm)	23" (58.4cm)	11-3/8" (28.9cm)	11-3/8" (28.9cm)
#7	Director		35-1/2" (90.1cm)	35-1/2" (90.1cm)	22-3/4" (57.8cm)	22-3/4" (57.8cm)		11-1/4" (28.5cm)
#8	Director		35-3/8" (89.9cm)	35-3/8" (89.9cm)		22-1/2" (57.2cm)		11-1/8" (28.3cm)
#9	Director		35-1/4" (89.5cm)	35-1/4" (89.5cm)		22-1/4" (56.5cm)		11" (27.9cm)
#10	Director		35-1/8" (89.2cm)	35-1/8" (89.2cm)		22" (55.9cm)		10-7/8" (27.6cm)
#11	Director		35" (88.9cm)	35" (88.9cm)		21-3/4" (55.2cm)		10-3/4" (27.3cm)

All antennas are supplied with one of each size element, except the A147-22 Power Pack has two of each size element. Cutting tolerance is 1/16" (.6mm) for all elements.

INSTALLATION SUGGESTIONS

Your Cushcraft VHF/UHF beam is designed and manufactured to give top performance and trouble free service. The antenna will perform as specified, if the instructions and suggestions are followed, and if care is used in assembly and installation.

MASTING: The mast mount brackets on the A147-11, A220-11, and A449-11 will take up to a 1 1/2" O.D. mast. A 1 1/4" O.D. television type tubing is satisfactory for any of the single beams. The A147-22 Power Pack may be mounted on a mast of up to 2" O.D. The A147-4, A220-7, and A449-6 have extra-length booms for mast or tower side mounting, and may be mounted on a support of up to 2" O.D.

MOUNTING: When mounting the beams on the same mast with other VHF/UHF antennas, they should be mounted at least 1/2 wave length (of the lower frequency) away from the other antennas. The beams may be mounted within 6 ft. of 6 meter or HF antennas. Generally, it is best to mount these beams above lower frequency antennas.

ROTOR: A good quality television antenna rotor will easily handle any of these antennas.

LOCATION of the antenna is very important. Surrounding objects such as trees, power lines, other antennas, etc. will seriously reduce efficiency. To minimize the effects of surrounding objects, mount the antenna as high and in the clear as possible. If metal guy wires are used, they should be broken with strain insulators. WARNING: THIS ANTENNA IS AN ELECTRICAL CONDUCTOR, CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION -REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. CONSULT THE NATIONAL ELECTRICAL CODE FOR FURTHER DETAILS.

ASSEMBLY INSTRUCTIONS

BOOM ASSEMBLY, A147-11, A220-7, and A220-11: Slide the 7/8" (2.2cm) section(s) into the 1" (2.5cm) center section, as far as the single black line. To align the boom sections, insert a 2" (5.1cm) bolt through one hole in each section, and sight along the boom. Tighten the sections securely with the 1" (2.5cm) telescope clamp(s).

ELEMENT ASSEMBLY: The elements for the A147-4, A147-11 and A220-11 (not including the dipole) are taped in one bundle. They are progressively shorter to improve bandwidth. For the A147-4, A220-7 and A449-6, mount the reflector (longest element) at the U-bolt end of the boom. The A-147-11 reflector may be mounted at either end of the boom. For the A220-11, mount the reflector at the end of the 1" (2.5cm) boom section. Mount the dipole next, then each progressively shorter director, up the front director (shortest element), Figure 1. All but the two end elements and dipole are preassembled on the booms of the A449-6 and A449-11. Mount them in the proper order as outlined onto the dipole and boom ends.

MAST MOUNT: The A147-4, A220-7 and A449-6 use a single U-bolt and bracket assembly, Figure 2. The A449-11 and A220-11 use a single U-bolt and bracket assembly, Figure 3. The A-147-11 uses a 4" x 6" (10.2 x 15.2 cm) plate mounted between the number 5 and 6 elements, figure 4. All of the antennas may be mounted for horizontal or vertical polarization. For vertical polarization, mount them with the Reddi Match rods pointing up. Keep the mast mount bracket on the opposite side of the boom from the elements. This will help to minimize pattern distortion from metallic masts.

TUNING: The Reddi Match is set at the factory for 50-ohm and center band operation. For best results, it should be individually tuned at your site, by using a good quality standing wave ratio bridge. It is not necessary to cut your feed line or prune it to a particular length; any length feed cable may be used with the beams. However, the cable should be as short as possible to reduce feed line losses. Your feed cable should be equipped with a standard PL-259 coaxial fitting, to connect to the Reddi Match, Figure 5.

Tune the antenna at your center frequency, using a 50-ohm feed line from your transmitter, and a reliable S.W.R. bridge or reflectometer. Connect the S.W.R. bridge to the antenna with a short length of RG-8/U or RG-58/U coaxial cable (preferably an electrical 1/2-wave length, so that the actual S.W.R. value at the antenna feed-point will be repeated at the bridge.) Slide the Reddi-Match tuning strap in either direction, to obtain the lowest S.W.R. reading. Move away from the antenna and check the reading. Repeat this procedure until the S.W.R. reading is at its lowest value. Disconnect the cable and bridge, and tighten the tuning strap securely.

When the antenna is completely assembled and tuned, tighten and tape the feed line connection, and coat with a clear acrylic spray or equal. The connections may be internally weatherproofed with silicone grease, if desired. Run the coaxial feed line along the boom, away from the elements, and down the mast. Use electrical tape to hold it in position.

STACKING KIT
PARTS LIST

DESCRIPTION	QUANTITY			
	A14-VPK	A147-VPK	A220-VPK	A449-VPK
1-5/8" (4.1cm) x 6" (15.2cm) center splice	1	1	1	-
1-1/4" (3.1cm) x 33" (83.8cm) boom	-	-	-	1
1-1/2" (3.8cm) x 27" (68.6cm) boom section	2	-	2	-
1-1/2" (3.8cm) x 41" (104.1cm) boom section	-	2	-	-
4" (10.2cm) x 6" (15.2cm) formed alum. mast plate	1	1	1	-
Coax harness assembly	1	1	1	1

STACKING KIT
PARTS PACKAGE

PART #	DESCRIPTION				
1	2" (5.1cm) U-bolt	2	2	2	-
2	1-5/8" (4.1cm) U-bolt	2	2	2	-
5	5/16" (.8cm) lock washer	8	8	8	2
6	5/16" (.8cm) hex nut	8	8	8	2
13	1-1/4" (3.2cm) plastic cap	-	-	-	2
15	1/4" (.6cm) flat steel washer	4	4	4	2
31	2"x4" (5.1 x 10.1cm) U-bolt	-	-	-	1
32	3-1/2" (8.9cm) U-bolt bracket	-	-	-	1
33	3-1/2" (8.9cm) U-bolt backing plate	-	-	-	1
46	1-1/2" (3.8cm) plastic cap	2	2	2	-

The following instructions apply to the A147-22 Power Pack and all of the VPK stacking kits. Refer to the single beam instructions for assembly and tuning of the individual antennas. Stacking two antennas will result in a system gain of nearly 3dB over that of a single antenna.

To assemble the A147-22, A147-VPK, A14-VPK and A220-VPK mounting booms, slide the 1 1/2" (3.8cm) sections into the 1-5/8" (4.10cm) center splice, as far as the single black line. The 4" x 6" (10.2 x 15.2cm) mounting plate and U-bolt clamp the sections together, Figure 6. The A449-VPK mounting boom uses a single U-bolt and bracket assembly in the center, Figure 2.

Mount the antennas on the ends of the support boom, using Chart 1, Dimension A, for the proper spacing, which is measured center-to-center on the antenna booms. For mechanical balance, it is best to keep the antenna booms below the support boom. The Reddi Match rods should be on the same side of the antenna booms, and pointing up. Press the plastic caps into the boom ends.

CHART 1

ANTENNA MODEL NO.	DUAL STACKING KIT	HARNESS NO.	DIMENSION A
A147-4	A14-VPK	A14-SK	50" (127cm)
A147-11	A147-VPK	A147-SK	76" (193cm)
A147-22		A147-SK	76" (193cm)
A220-7		A220-SK	50" (127cm)
A220-11	A220-VPK	A220-SK	50" (127cm)
A449-6	A449-VPK	A449-SK	25" (63.5cm)
A449-11	A449-VPK	A449-SK	25" (63.5cm)

Dimension "A" is from center-to-center.

Two arrays can be mounted in a quad configuration by using the appropriate coaxial harness between the dual arrays, Chart 1. In this case, the gain of the system will be nearly 6dB over that of a single antenna.

Rear mounted antennas, such as the A147-4, A220-7, or A440-6, may be stacked along the side of the tower, one above the other. The tower should have little influence upon tuning, since it is behind the reflector elements. Recommended phasing harnesses and center-to-center stacking distances are given in Chart 1. For this configuration, the horizontal beamwidth of the array will be the same as for a single antenna, provided that the antenna booms are in the same direction. However, the vertical beamwidth (above and below the horizon) will be considerably narrower than that of a single antenna.

A stacked array consisting of two or four antennas may be conveniently tuned at ground level by temporarily resting the array on wooden or insulated supports so that the antennas are pointed up into the sky, and the reflector elements are parallel to and a few feet above the ground. Conducting objects behind the reflectors have little influence on antenna tuning, but be sure that the sky and area around the array is free from obstacles, such as buildings, wires, trees, etc. All antennas in the array should have the Reddi-Match units pointed in the same direction, so that they will be phased.

Before connecting the phasing harness cables, tune each antenna at your center frequency, using a 50 ohm feedline from your transmitter, and a reliable S.W.R. bridge or reflectometer. Follow the procedure given for tuning a single antenna.

After tuning the antennas, tighten all connections, connect the harness and neatly dress and tape the cables along the booms and frame members. Excess cable may be coiled up equally on each side.

The SWR for the completed array may now be checked at the central coaxial "T"-connector using your 50 ohm feedline and SWR indicator. The SWR value should be low. It will not change appreciably, if the antenna is mounted high and in the clear.

Before final installation on your tower mast, install the connector boot over the connector. Apply the silicone grease around the PL259

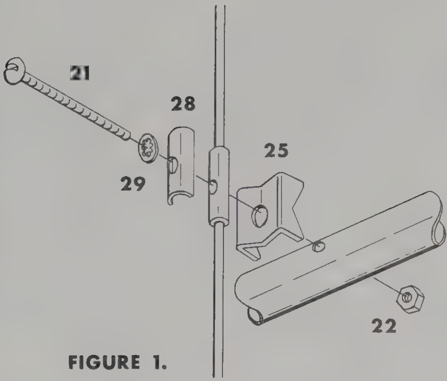

FIGURE 1.

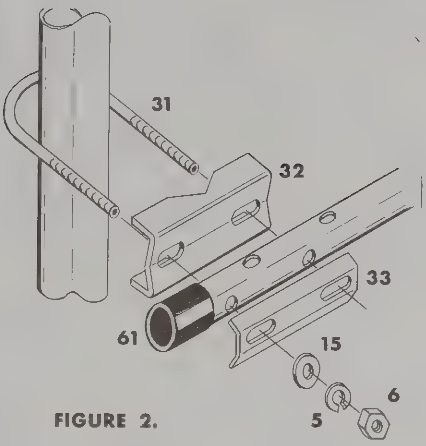

FIGURE 2.

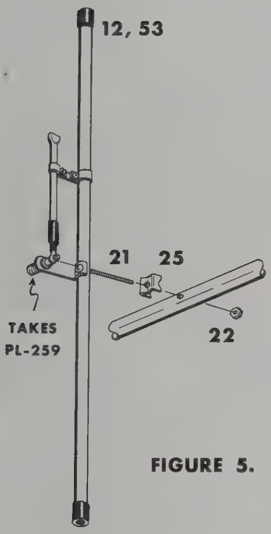

FIGURE 5.

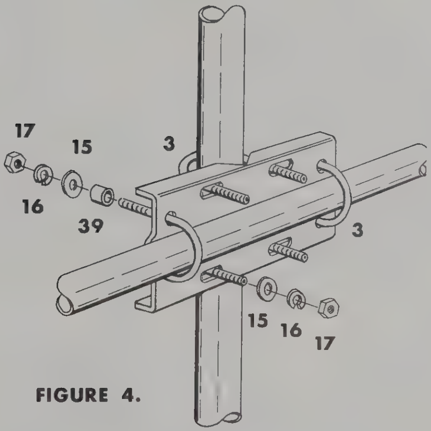

FIGURE 4.

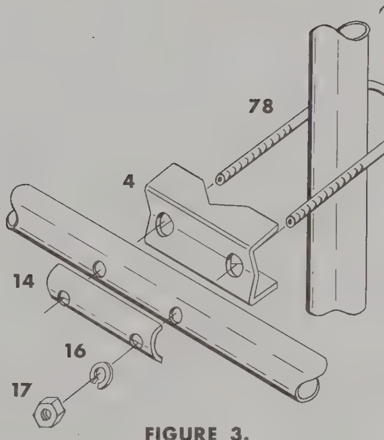

FIGURE 3.

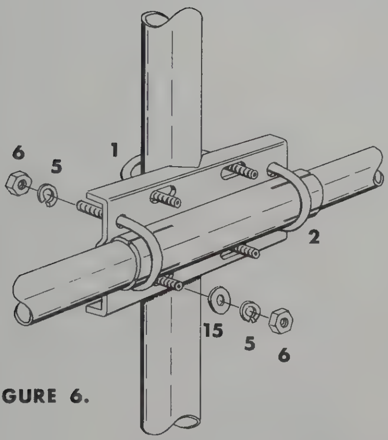

FIGURE 6.

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CUSHCRAFT CORPORATION, P. O. BOX 4680, MANCHESTER, NEW HAMPSHIRE 03108 WARRANTS TO THE ORIGINAL CONSUMER PURCHASER FOR ONE YEAR FROM DATE OF PURCHASE THAT EACH CUSHCRAFT ANTENNA IS FREE OF DEFECTS IN MATERIAL OR WORKMANSHIP. IF, IN THE JUDGMENT OF CUSHCRAFT, ANY SUCH ANTENNA IS DEFECTIVE, THEN CUSHCRAFT CORPORATION WILL, AT ITS OPTION, REPAIR OR REPLACE THE ANTENNA AT ITS EXPENSE WITHIN THIRTY DAYS OF THE DATE THE ANTENNA IS RETURNED (AT PURCHASER'S EXPENSE) TO CUSHCRAFT OR ONE OF ITS AUTHORIZED REPRESENTATIVES. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESSED WARRANTIES. ANY IMPLIED WARRANTY IS LIMITED IN DURATION TO ONE YEAR. CUSHCRAFT CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM A DEFECT. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR EXCLUSIONS OR LIMITATIONS OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION AND EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. THIS WARRANTY DOES NOT EXTEND TO ANY PRODUCTS WHICH HAVE BEEN SUBJECT TO MISUSE, NEGLECT, ACCIDENT OR IMPROPER INSTALLATION. ANY REPAIRS OR ALTERATIONS OUTSIDE OF THE CUSHCRAFT FACTORY WILL NULIFY THIS WARRANTY.

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SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

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ASSEMBLY INSTRUCTIONS

A147-4, A147-11, A147-22, A220-7, A220-11, A449-6, A449-11

A14-VPK, A147-VPK, A220-VPK, A449-VPK

951277

SPECIFICATIONS

MODEL	A147-4	A147-11	A147-22	A220-7	A220-11	A449-6	A449-11
Frequency, MHz	146-148	146-148	146-148	220-225	220-225	440-450	440-450
2:1 VSWR bandwidth	4 MHz	3 MHz	3 MHz	5 MHz	5 MHz	10 MHz	10 MHz
Gain	9.0 dBd	11.3 dBd	14.2 dBd	10.5 dBd	11.3 dBd	10.0 dBd	11.3 dBd
Front-to-back ratio	18 dB	20 dB	20 dB	20 dB	20 dB	18 dB	20 dB
3-dB beamwidth	66°	48°	42°	57°	48°	60°	48°
Boom length	44" (1.1m)	144" (3.6m)	144" (3.6m)	69" (1.7m)	102" (2.6m)	35" (89cm)	60" (1.5cm)
Longest element	40" (1.0m)	40" (1.0m)	40" (1.0m)	27" (66cm)	26" (66cm)	13" (33cm)	13" (33cm)
Turning radius	44" (1.1m)	72" (1.8m)	85" (2.2m)	69" (1.7m)	51" (1.3m)	18" (46cm)	60" (1.5m)
Wind area	0.43 ft² (.04m²)	1.21 ft² (.11m²)	1.42 ft² (1.13m²)	0.48 ft² (.04m²)	0.50 ft² (.05m²)	0.30 ft² (.03m²)	0.39 ft² (0.4m²)
Weight	3 lb (1.4kg)	6 lb (2.7kg)	15 lb (6.7kg)	2 lb (.9kg)	5 lb (2.3kg)	3 lb (1.4kg)	4 lb (1.8kg)
Maximum mast OD	2" (5.0cm)	1-1/2" (3.8cm)	2" (5.0cm)	2" (5.0cm)	1-1/2" (3.8cm)	2" (5.0cm)	1-1/2" (3.8cm)

PARTS PACKAGE

PART NO.	DESCRIPTION	A147-4	A147-11	A147-22	A220-7	A220-11	A449-6	A449-11
1	2" (5.0cm) I.D. U-bolt			2				
2	1-5/8" (4.1cm) I.D. U-bolt			2				
3	1 1/2" (3.8cm) I.D. U-bolt		4	8				
4	Bracket for 1 1/2" (3.8cm) U-bolt					1		1
5	5/16" (.8cm) I.D. lock washer	2		8	2		2	
6	5/16" (.8cm) I.D. hex nut	2		8	2		2	
14	Backing plate for 1 1/2" (3.8cm) U-bolt					1		1
15	5/16" (.8cm) I.D. flat steel washer	2	8	20	2		2	
16	1/4"-20 lock washer		8	16		2		2
17	1/4"-20 hex nut		8	16		2		
21	#10-24 x 2" (5.0cm) machine screw	3	10	20	6	10	2	2
22	#10-24 hex nut	3	10	20	6	10	2	2
25	7/8" (2.2cm) formed aluminum bracket	3	10	20	6	10	2	2
28	Aluminum half washer	3	10	20	6	10	2	2
29	#10 internal-tooth lock washer	3	10	20	6	10	2	2
31	2" (5.0cm) I.D. x 4" (10.1cm) U-bolt	1			1		1	
32	Bracket for 2" (5.0cm) x 4" (10.1cm) U-bolt	1			1		1	
33	Bracking plate for 2" (5.0cm) x 4" (10.1cm) U-bolt	1			1		1	
38	1" (2.5cm) plastic cap				1	1		2
39	3/8" (.9cm) I.D. aluminum spacer		4	8				
46	1 1/2" (3.8cm) plastic cap			2				
53	1/2" (1.2cm) plastic cap		2	4	2	2	2	2
61	7/8" (2.2cm) plastic cap	2	2	4	1	1	2	
78	1 1/2" (3.8cm) I.D. x 3 1/2" (8.8cm) U-bolt					1		1
G10	1" (2.5cm) telescope clamp		2	4	1	1		

PARTS LIST

DESCRIPTION	QUANTITY A147-4	A147-11	A147-22	A220-7	A220-11	A449-6	A449-11
7/8" (2.2cm) x 24" (61.0cm) boom section				1			
7/8" (2.2cm) x 35" (88.9cm) boom						1	
7/8" (2.2cm) x 44" (111.8cm) boom	1						
7/8" (2.2cm) x 50" (127.0cm) boom section		2	4				
7/8" (2.2cm) x 56" (134.6cm) boom section					1		
1" (2.5cm) x 48" (121.9cm) boom section		1	2	1	1		
1" (2.5cm) x 53" (134.6cm) boom							1
1-5/8" (4.1cm) x 6" (15.2cm) center splice			1				
1-1/2" (3.8cm) x 41" (104.1cm) boom section			2				
4" (10.2cm) x 6" (15.2cm) formed alum. mast plate		1	3				

ELEMENTS		LENGTH A147-4	A147-11	A147-22	A220-7	A220-11	A449-6	A449-11
#1	Reflector	39-3/4" (100cm)	40" (101.6cm)	40" (101.6cm)	26-1/4" (66,7cm)	26-1/4" (66.7cm)	13-1/8" (33.3cm)	13-1/8" (33.3cm)
#2	Dipole	38" (96.5cm)	37-7/8" (96.2cm)	37-7/8" (96.2cm)	24-15/16" (63.3cm)	24-15/16" (63.3cm)	12-3/8" (31.4cm)	12-3/8" (31.4cm)
#3	Director	36" (91.4cm)	36" (91.4cm)	36" (91.4cm)	23-3/4" (60.3cm)	23-3/4" (60.3cm)	11-3/4" (29.8cm)	11-3/4 (29.8cm)
#4	Director	35-3/4" (90.8cm)	35-7/8" (91.1cm)	35-7/8" (91.1cm)	23-1/2" (59.7cm)	23-1/2" (59.7cm)	11-5/8" (29.5cm)	11-5/8" (29.5cm)
#5	Director		35-3/4" (90.8cm)	35-3/4" (90.8cm)	23-1/4" (59.1cm)	23-1/4" (59.1cm)	11-1/2" (29.2cm)	11-1/2" (29.2cm)
#6	Director		35-5/8" (90.5cm)	35-5/8" (90.5cm)	23" (58.4cm)	23" (58.4cm)	11-3/8" (28.9cm)	11-3/8" (28.9cm)
#7	Director		35-1/2" (90.1cm)	35-1/2" (90.1cm)	22-3/4" (57.8cm)	22-3/4" (57.8cm)		11-1/4" (28.5cm)
#8	Director		35-3/8" (89.9cm)	35-3/8" (89.9cm)		22-1/2" (57.2cm)		11-1/8" (28.3cm)
#9	Director		35-1/4" (89.5cm)	35-1/4" (89.5cm)		22-1/4" (56.5cm)		11" (27.9cm)
#10	Director		35-1/8" (89.2cm)	35-1/8" (89.2cm)		22" (55.9cm)		10-7/8" (27.6cm)
#11	Director		35" (88.9cm)	35" (88.9cm)		21-3/4" (55.2cm)		10-3/4" (27.3cm)

All antennas are supplied with one of each size element, except the A147-22 Power Pack has two of each size element. Cutting tolerance is 1/16" (.6mm) for all elements.

INSTALLATION SUGGESTIONS

Your Cushcraft VHF/UHF beam is designed and manufactured to give top performance and trouble free service. The antenna will perform as specified, if the instructions and suggestions are followed, and if care is used in assembly and installation.

MASTING: The mast mount brackets on the A147-11, A220-11, and A449-11 will take up to a 1 1/2" O.D. mast. A 1 1/4" O.D. television type tubing is satisfactory for any of the single beams. The A147-22 Power Pack may be mounted on a mast of up to 2" O.D. The A147-4, A220-7, and A449-6 have extra-length booms for mast or tower side mounting, and may be mounted on a support of up to 2" O.D.

MOUNTING: When mounting the beams on the same mast with other VHF/UHF antennas, they should be mounted at least 1/2 wave length (of the lower frequency) away from the other antennas. The beams may be mounted within 6 ft. of 6 meter or HF antennas. Generally, it is best to mount these beams above lower frequency antennas.

ROTOR: A good quality television antenna rotor will easily handle any of these antennas.

LOCATION of the antenna is very important. Surrounding objects such as trees, power lines, other antennas, etc. will seriously reduce efficiency. To minimize the effects of surrounding objects, mount the antenna as high and in the clear as possible. If metal guy wires are used, they should be broken with strain insulators. WARNING: THIS ANTENNA IS AN ELECTRICAL CONDUCTOR, CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION -REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. CONSULT THE NATIONAL ELECTRICAL CODE FOR FURTHER DETAILS.

ASSEMBLY INSTRUCTIONS

BOOM ASSEMBLY, A147-11, A220-7, and A220-11: Slide the 7/8" (2.2cm) section(s) into the 1" (2.5cm) center section, as far as the single black line. To align the boom sections, insert a 2" (5.1cm) bolt through one hole in each section, and sight along the boom. Tighten the sections securely with the 1" (2.5cm) telescope clamp(s).

ELEMENT ASSEMBLY: The elements for the A147-4, A147-11 and A220-11 (not including the dipole) are taped in one bundle. They are progressively shorter to improve bandwidth. For the A147-4, A220-7 and A449-6, mount the reflector (longest element) at the U-bolt end of the boom. The A-147-11 reflector may be mounted at either end of the boom. For the A220-11, mount the reflector at the end of the 1" (2.5cm) boom section. Mount the dipole next, then each progressively shorter director, up the front director (shortest element), Figure 1. All but the two end elements and dipole are preassembled on the booms of the A449-6 and A449-11. Mount them in the proper order as outlined onto the dipole and boom ends.

MAST MOUNT: The A147-4, A220-7 and A449-6 use a single U-bolt and bracket assembly, Figure 2. The A449-11 and A220-11 use a single U-bolt and bracket assembly, Figure 3. The A-147-11 uses a 4" x 6" (10.2 x 15.2 cm) plate mounted between the number 5 and 6 elements, figure 4. All of the antennas may be mounted for horizontal or vertical polarization. For vertical polarization, mount them with the Reddi Match rods pointing up. Keep the mast mount bracket on the opposite side of the boom from the elements. This will help to minimize pattern distortion from metallic masts.

TUNING: The Reddi Match is set at the factory for 50-ohm and center band operation. For best results, it should be individually tuned at your site, by using a good quality standing wave ratio bridge. It is not necessary to cut your feed line or prune it to a particular length; any length feed cable may be used with the beams. However, the cable should be as short as possible to reduce feed line losses. Your feed cable should be equipped with a standard PL-259 coaxial fitting, to connect to the Reddi Match, Figure 5.

Tune the antenna at your center frequency, using a 50-ohm feed line from your transmitter, and a reliable S.W.R. bridge or reflectometer. Connect the S.W.R. bridge to the antenna with a short length of RG-8/U or RG-58/U coaxial cable (preferably an electrical 1/2-wave length, so that the actual S.W.R. value at the antenna feed-point will be repeated at the bridge.) Slide the Reddi-Match tuning strap in either direction, to obtain the lowest S.W.R. reading. Move away from the antenna and check the reading. Repeat this procedure until the S.W.R. reading is at its lowest value. Disconnect the cable and bridge, and tighten the tuning strap securely.

When the antenna is completely assembled and tuned, tighten and tape the feed line connection, and coat with a clear acrylic spray or equal. The connections may be internally weatherproofed with silicone grease, if desired. Run the coaxial feed line along the boom, away from the elements, and down the mast. Use electrical tape to hold it in position.

STACKING KIT
PARTS LIST

DESCRIPTION	QUANTITY A14-VPK	A147-VPK	A220-VPK	A449-VPK
1-5/8" (4.1cm) x 6" (15.2cm) center splice	1	1	1	-
1-1/4" (3.1cm) x 33" (83.8cm) boom	-	-	-	1
1-1/2" (3.8cm) x 27" (68.6cm) boom section	2	-	2	-
1-1/2" (3.8cm) x 41" (104.1cm) boom section	-	2	-	-
4" (10.2cm) x 6" (15.2cm) formed alum. mast plate	1	1	1	-
Coax harness assembly	1	1	1	1

STACKING KIT
PARTS PACKAGE

PART #	DESCRIPTION				
1	2" (5.1cm) U-bolt	2	2	2	-
2	1-5/8" (4.1cm) U-bolt	2	2	2	-
5	5/16" (.8cm) lock washer	8	8	8	2
6	5/16" (.8cm) hex nut	8	8	8	2
13	1-1/4" (3.2cm) plastic cap	-	-	-	2
15	1/4" (.6cm) flat steel washer	4	4	4	2
31	2"x4" (5.1 x 10.1cm) U-bolt	-	-	-	1
32	3-1/2" (8.9cm) U-bolt bracket	-	-	-	1
33	3-1/2" (8.9cm) U-bolt backing plate	-	-	-	1
46	1-1/2" (3.8cm) plastic cap	2	2	2	-

The following instructions apply to the A147-22 Power Pack and all of the VPK stacking kits. Refer to the single beam instructions for assembly and tuning of the individual antennas. Stacking two antennas will result in a system gain of nearly 3dB over that of a single antenna.

To assemble the A147-22, A147-VPK, A14-VPK and A220-VPK mounting booms, slide the 1 1/2" (3.8cm) sections into the 1-5/8" (4.10cm) center splice, as far as the single black line. The 4" x 6" (10.2 x 15.2cm) mounting plate and U-bolt clamp the sections together, Figure 6. The A449-VPK mounting boom uses a single U-bolt and bracket assembly in the center, Figure 2.

Mount the antennas on the ends of the support boom, using Chart 1, Dimension A, for the proper spacing, which is measured center-to-center on the antenna booms. For mechanical balance, it is best to keep the antenna booms below the support boom. The Reddi Match rods should be on the same side of the antenna booms, and pointing up. Press the plastic caps into the boom ends.

CHART 1

ANTENNA MODEL NO.	DUAL STACKING KIT	HARNESS NO.	DIMENSION A
A147-4	A14-VPK	A14-SK	50" (127cm)
A147-11	A147-VPK	A147-SK	76" (193cm)
A147-22		A147-SK	76" (193cm)
A220-7		A220-SK	50" (127cm)
A220-11	A220-VPK	A220-SK	50" (127cm)
A449-6	A449-VPK	A449-SK	25" (63.5cm)
A449-11	A449-VPK	A449-SK	25" (63.5cm)

Dimension "A" is from center-to-center.

Two arrays can be mounted in a quad configuration by using the appropriate coaxial harness between the dual arrays, Chart 1. In this case, the gain of the system will be nearly 6dB over that of a single antenna.

Rear mounted antennas, such as the A147-4, A220-7, or A440-6, may be stacked along the side of the tower, one above the other. The tower should have little influence upon tuning, since it is behind the reflector elements. Recommended phasing harnesses and center-to-center stacking distances are given in Chart 1. For this configuration, the horizontal beamwidth of the array will be the same as for a single antenna, provided that the antenna booms are in the same direction. However, the vertical beamwidth (above and below the horizon) will be considerably narrower than that of a single antenna.

A stacked array consisting of two or four antennas may be conveniently tuned at ground level by temporarily resting the array on wooden or insulated supports so that the antennas are pointed up into the sky, and the reflector elements are parallel to and a few feet above the ground. Conducting objects behind the reflectors have little influence on antenna tuning, but be sure that the sky and area around the array is free from obstacles, such as buildings, wires, trees, etc. All antennas in the array should have the Reddi-Match units pointed in the same direction, so that they will be phased.

Before connecting the phasing harness cables, tune each antenna at your center frequency, using a 50 ohm feedline from your transmitter, and a reliable S.W.R. bridge or reflectometer. Follow the procedure given for tuning a single antenna.

After tuning the antennas, tighten all connections, connect the harness and neatly dress and tape the cables along the booms and frame members. Excess cable may be coiled up equally on each side.

The SWR for the completed array may now be checked at the central coaxial "T"-connector using your 50 ohm feedline and SWR indicator. The SWR value should be low. It will not change appreciably, if the antenna is mounted high and in the clear.

Before final installation on your tower mast, install the connector boot over the connector. Apply the silicone grease around the PL259

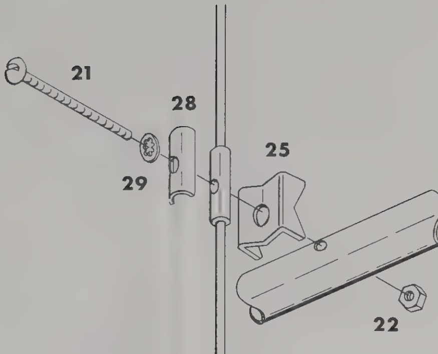

FIGURE 1.

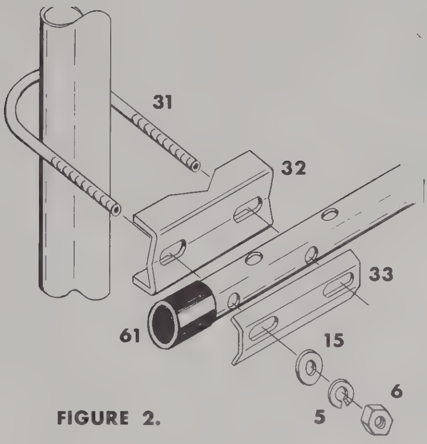

FIGURE 2.

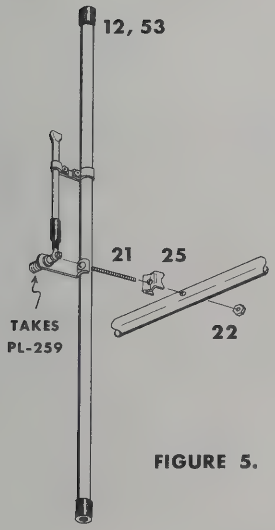

FIGURE 5.

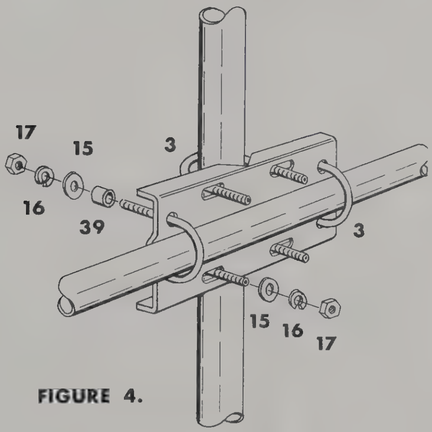

FIGURE 4.

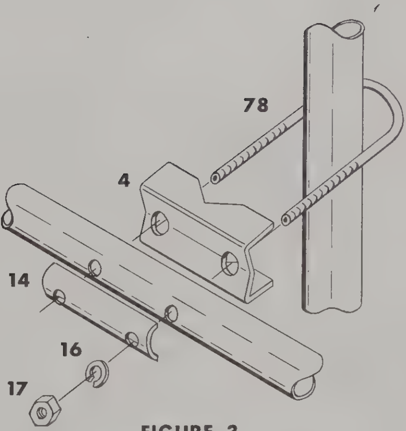

FIGURE 3.

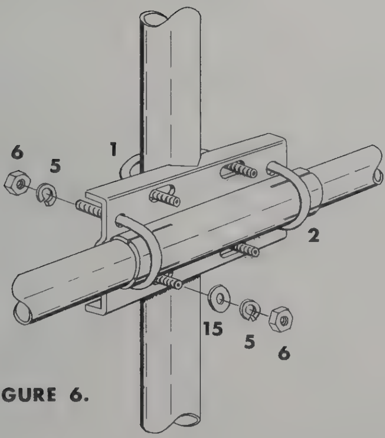

FIGURE 6.

" LIMITED WARRANTY "

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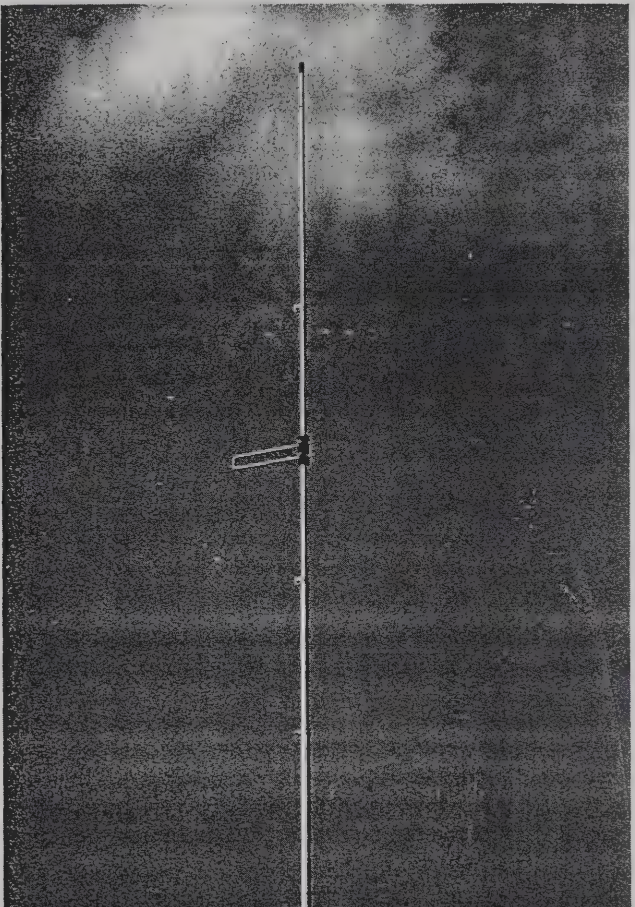
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

ASSEMBLY AND INSTALLATION INSTRUCTIONS



ARX-2B,
ARX-220B,
and ARX-450B

Ringo Ranger II Antenna

cushcraft
CORPORATION

A100880

Your Cushcraft Ringo Ranger II is designed and manufactured to give top performance and trouble free service. The antenna will perform as specified if the instructions and suggestions are followed and care is used in assembly and installation.

Masting

The ARX-2B and ARX-220B will take up to a 1⅜" (3.5 cm) OD mast. For most installations a 1¼" (3.2 cm) OD TV type mast will be satisfactory. The ARX-450B will take up to a 1" (2.5 cm) OD mast. A total of 55" (139.7 cm) of exposed mast is necessary to install the ARX-2B. The ARX-220B requires 38" (91.4 cm) and the ARX-450B needs 20" (50.8 cm).

Location

Location of the antenna is very important. Surrounding objects such as trees, power lines, other antennas, etc. will seriously reduce efficiency. To minimize the effects of surrounding objects, mount the antenna as high and in the clear as possible. If metal guy wires are used, they should be broken with strain insulators. WARNING: THIS ANTENNA IS AN ELECTRICAL CONDUCTOR, CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. FOLLOW THE GUIDELINES FOR ANTENNA INSTALLATIONS RECOMMENDED BY THE U.S. CONSUMER PRODUCT SAFETY COMMISSION AND LISTED IN THE ENCLOSED PAMPHLET.

Mounting

Several antennas may be mounted on the same mast. Your Ringo Ranger II may be mounted on the top of a beam antenna. When side mounting your Ringo Ranger II on a tower, it should be kept at least ¼ wavelength out from the tower.

Antenna Assembly

Attach the matching ring as shown in figure 2. Assemble the tuning rod clamp, place it over the tuning ring and slide the tuning rod through it. Attach the flattened end of the coax connector. Be sure the tuning rod is on the proper side of the base.

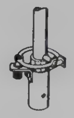
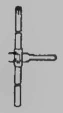
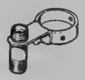
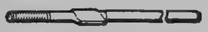
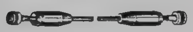
Using figure 1 assemble the radiating section. Adjust dimensions A, B, and C using chart A. Tighten all fasteners snugly.

Assemble the radial ring as shown in figure 3. Then slide it into position, attach the coaxial line between the matching ring and the radial ring. Coat the outside of the aluminum connector threads and the PL-259 with silicone grease provided. Do not coat the connector center pin and socket with silicone. Slide the vinyl boots over the connectors and against the plate for a good weather-tight connection. Follow the same procedure for your 50 ohm coaxial feed cable and be sure to slide the vinyl boot over the cable before attaching the PL-259 connector. Tighten the radials snugly and evenly to the mast. DO NOT OVER TIGHTEN. Over tightening may cause perminent unwarranteed damage. (See Steps 1 and 2.)

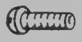
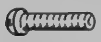
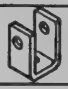
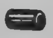
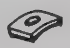
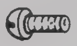
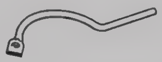
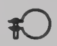
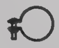
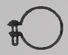
Tuning

Mount the antenna clear of surrounding objects. Keep all metal obstructions such as guy wires and other antennas at least 25 feet away. Attach a good quality VSWR bridge in the coaxial cable as close to the antenna as possible and note the VSWR at your frequency. For the ARX-2B and ARX-220B move the tuning rod for lowest VSWR. For the ARX-450B adjust the length of the lower section for minimum VSWR.

PARTS LIST ARX-450B

	DISPLAY	DESC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY w/ RING		1
LL		PHASING STUB ASSEMBLY	3/8" x 28 3/4" (0.9 x 73.0 cm)	1
KK		RADIAL RING ASSEMBLY		1
JJ		ALUM. RADIAL ROD	1/4" x 6 3/4" (0.64 x 17.1 cm)	3
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	17" (43.1 cm)	1

PARTS PACKAGE ARX-2B, ARX-220B

P/N	DETAIL	DESC.	SIZE	QTY.
9		MACHINE SCREW	8-32 x 5/8" (1.6 cm)	2
10		INTERNAL TOOTH WASHER	#8	3
11		HEX NUT	#8-32	4
81		MACHINE SCREW	1/4" - 20 x 3/4 (1.9 cm)	1
67		TUNING ROD CLAMP		1
77		PLASTIC CAP	3/8" (0.9 cm)	1
94		LOCK NUT	1/4" - 20 (.64 cm)	1
96		MACHINE SCREW	#8-32 x 3/8" (0.9 cm)	2
97		FORMED TUNING ROD	3/16" x 5" (0.48 x 12.7 cm	1
G-6		TELESCOPE CLAMP	1/2" (1.3 cm)	1
G-7		TELESCOPE CLAMP	5/8" (1.6 cm)	1
G-8		TELESCOPE CLAMP	3/4" (1.91 cm)	1
85		HEX NUT	1/4" - 20 (0.64 cm)	3
84		LOCK WASHER	1/4" (0.64 cm)	3

PARTS PACKAGE ARX-450B

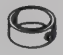
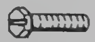
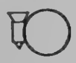
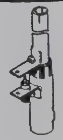
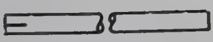
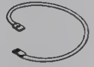
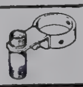
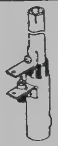
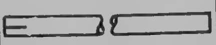
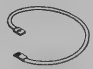
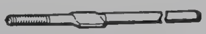
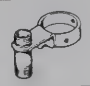
P/N	DISPLAY	DESC.	SIZE	QTY.
85		HEX NUT	1/4" - 20 (0.64 cm)	3
84		LOCK WASHER	1/4" (0.64 cm)	3
155		LOCKING RING		1
80		MACHINE SCREW	8-32 x 1/2" (1.6 cm)	1
11		8-32 HEX NUT		
GS-4 SS		WORM CLAMP		

CHART A			
Freq. MHz	Dimension A	Dimension B	Dimension C
ARX-2B			
135	59 1/2" (1.51 m)	54 1/2" (1.38 m)	9 3/4" (24.8 cm)
137	58 3/4" (1.49 m)	53 3/4" (1.36 m)	9 1/2" (24.1 cm)
140	57 1/2" (1.46 m)	52 1/2" (1.33 m)	9 1/4" (23.5 cm)
142	56 3/4" (1.44 m)	51 3/4" (1.31 m)	9 1/8" (23.2 cm)
145	55 1/2" (1.41 m)	50 1/2" (1.28 m)	9" (22.9 cm)
146	55 1/8" (1.40 m)	50 1/8" (1.27 m)	8 9/16" (22.7 cm)
147	54 3/4" (1.39 m)	49 3/4" (1.26 m)	8 7/8" (22.5 cm)
150	53 1/2" (1.36 m)	48 3/4" (1.24 m)	8 3/4" (22.2 cm)
152	52 3/4" (1.34 m)	48" (1.22 m)	8 5/8" (21.9 cm)
155	51 3/4" (1.31 m)	47" (1.19 m)	8 1/2" (21.6 cm)
157	51" (1.29 m)	46 1/4" (1.17 m)	8 3/8" (21.3 cm)
160	50" (1.27 m)	45 1/2" (1.16 m)	8 1/4" (21.0 cm)
ARX-220B			
220-225	33 1/8" (84.1 cm)	32" (81.3 cm)	5 3/4" (14.6 cm)
ARX-450B			
435-450	17" (43.2 cm)	NONE	3" (7.6 cm)
450-470	16 1/2" (41.9 cm)	NONE	2 7/8" (7.3 cm)

PARTS LIST ARX-2B

P/N	DISPLAY	DISC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY		1 ✗
BB		ALUM. TUBING	5/8" x 15" (1.6 x 38.1 cm)	1 ✗
CC		ALUM. TUBING	1/2" x 21" (1.3 x 53.3 cm)	1 ✗
DD		ALUM. TUBING w/ INSULATOR	1/2" x 24" (1.3 x 70 cm)	1 ✗
EE		ALUM. TUBING	3/8" x 35" (0.9 x 88.9 cm)	1 ✗
FF		ALUM. PHASING STUB	10 1/2" (26.6 cm)	1 ✗
GG		ROD BASE RING	5" ROUND x 1/4" (12.7 x 0.64 cm)	1 ✗
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	50 1/2" (127.2 cm)	1 ✗
JJ		ALUM. RADIAL RODS	1/4" x 20 1/2" (0.64 x 52.1 cm)	3 ✗
KK		RADIAL RING ASSEMBLY		1 ✗

PARTS LIST ARX-220B

P/N	DETAIL	DESC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY		1
BB		ALUM. TUBING	5/8" x 15" (1.59 x 38.1 cm)	1
CC		ALUM. TUBING	1/2" x 12" (1.2 x 30.5 cm)	1
DD		ALUM. TUBING w/ INSULATOR	1/2" x 12" (1.2 x 30.5 cm)	1
EE		ALUM. TUBING	3/8" x 24" (0.9 x 61 cm)	1
FF		ALUM. PHASING STUB	6 3/4" (17.1 cm)	1
GG		ROD BASE RING	5" ROUND x 1/4" (12.7 x 0.64 cm)	1
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	33" (83.8 cm)	1
JJ		ALUM. RADIAL RODS	1/4" x 13 1/4" (0.64 x 33.7 cm)	3
KK		RADIAL RING ASSEMBLY		1

ARX-2B, ARX-220B

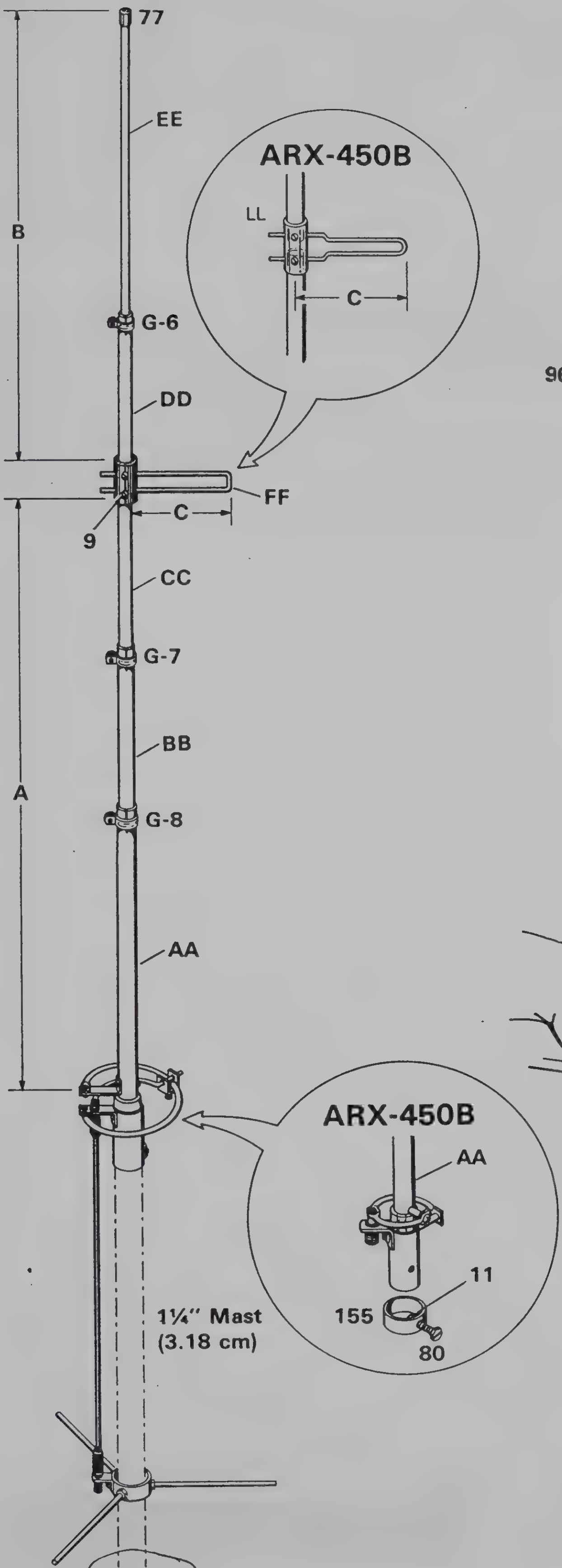


Fig. 1

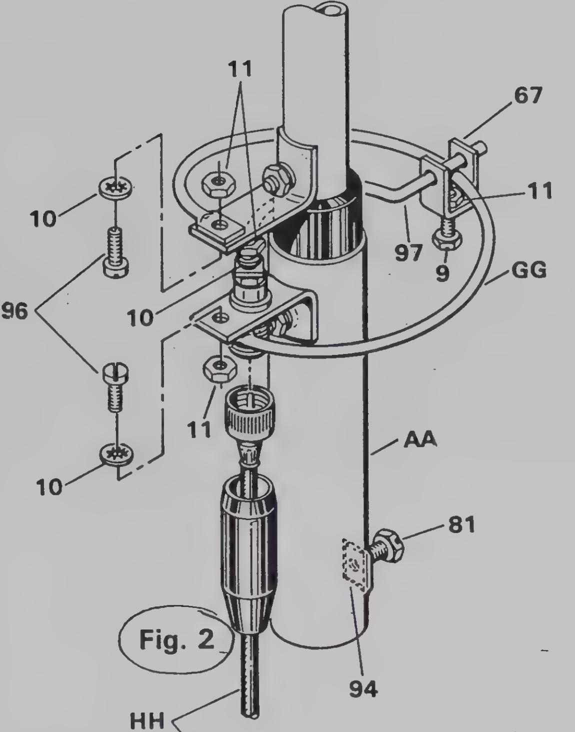


Fig. 2

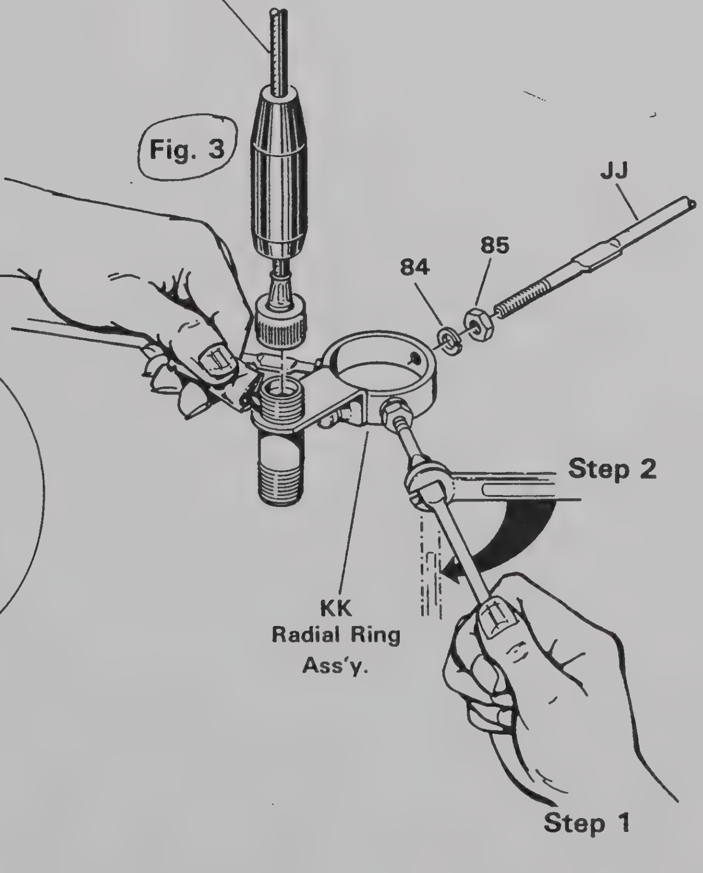


Fig. 3

LIMITED WARRANTY

CUSHCRAFT CORPORATION, P.O. BOX 4680, MANCHESTER, NEW HAMPSHIRE 03108, WARRANTS TO THE ORIGINAL CONSUMER PURCHASER FOR ONE YEAR FROM DATE OF PURCHASE THAT EACH CUSHCRAFT ANTENNA IS FREE OF DEFECTS IN MATERIAL OR WORKMANSHIP. IF, IN THE JUDGEMENT OF CUSHCRAFT, ANY SUCH ANTENNA IS DEFECTIVE, THEN CUSHCRAFT CORPORATION WILL, AT ITS OPTION, REPAIR OR REPLACE THE ANTENNA AT ITS EXPENSE WITHIN THIRTY DAYS OF THE DATE THE ANTENNA IS RETURNED (AT PURCHASER'S EXPENSE) TO CUSHCRAFT OR ONE OF ITS AUTHORIZED REPRESENTATIVES. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESSED WARRANTIES. ANY IMPLIED WARRANTY IS LIMITED IN DURATION TO ONE YEAR. CUSHCRAFT CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM A DEFECT. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR EXCLUSIONS OR LIMITATIONS OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION AND EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. THIS WARRANTY DOES NOT EXTEND TO ANY PRODUCTS WHICH HAVE BEEN SUBJECT TO MISUSE, NEGLECT, ACCIDENT OR IMPROPER INSTALLATION. ANY REPAIRS OR ALTERATIONS OUTSIDE OF THE CUSHCRAFT FACTORY WILL NULIFY THIS WARRANTY.

cushcraft
CORPORATION

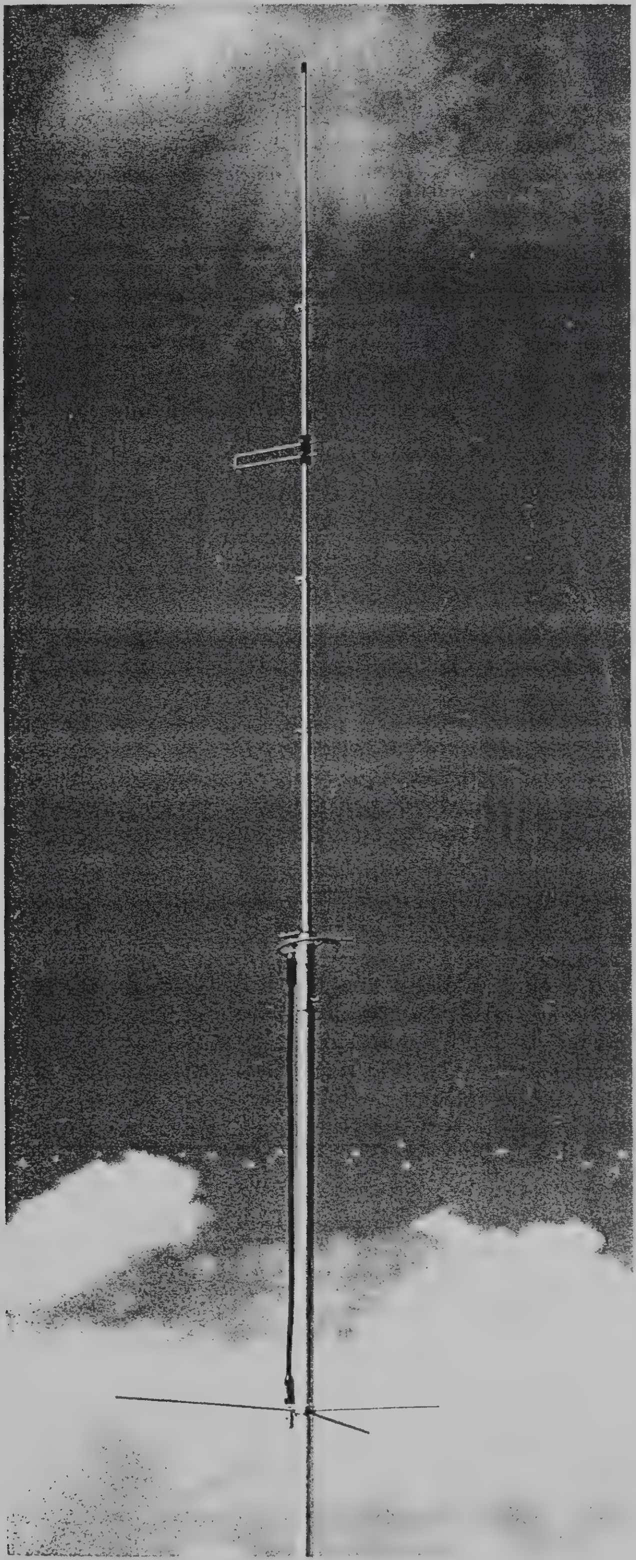
P.O. BOX 4680, MANCHESTER, N.H. 03108

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

ASSEMBLY AND INSTALLATION INSTRUCTIONS

ARX-2B,
ARX-220B,
and ARX-450B

Ringo Ranger II Antenna



CUSHCRAFT CORPORATION

A100880

Your Cushcraft Ringo Ranger II is designed and manufactured to give top performance and trouble free service. The antenna will perform as specified if the instructions and suggestions are followed and care is used in assembly and installation.

Masting

The ARX-2B and ARX-220B will take up to a 1⅜" (3.5 cm) OD mast. For most installations a 1¼" (3.2 cm) OD TV type mast will be satisfactory. The ARX-450B will take up to a 1" (2.5 cm) OD mast. A total of 55" (139.7 cm) of exposed mast is necessary to install the ARX-2B. The ARX-220B requires 38" (91.4 cm) and the ARX-450B needs 20" (50.8 cm).

Location

Location of the antenna is very important. Surrounding objects such as trees, power lines, other antennas, etc. will seriously reduce efficiency. To minimize the effects of surrounding objects, mount the antenna as high and in the clear as possible. If metal guy wires are used, they should be broken with strain insulators. WARNING: THIS ANTENNA IS AN ELECTRICAL CONDUCTOR, CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. FOLLOW THE GUIDELINES FOR ANTENNA INSTALLATIONS RECOMMENDED BY THE U.S. CONSUMER PRODUCT SAFETY COMMISSION AND LISTED IN THE ENCLOSED PAMPHLET.

Mounting

Several antennas may be mounted on the same mast. Your Ringo Ranger II may be mounted on the top of a beam antenna. When side mounting your Ringo Ranger II on a tower, it should be kept at least ¼ wavelength out from the tower.

Antenna Assembly

Attach the matching ring as shown in figure 2. Assemble the tuning rod clamp, place it over the tuning ring and slide the tuning rod through it. Attach the flattened end of the coax connector. Be sure the tuning rod is on the proper side of the base.

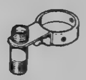
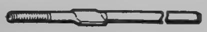
Using figure 1 assemble the radiating section. Adjust dimensions A, B, and C using chart A. Tighten all fasteners snugly.

Assemble the radial ring as shown in figure 3. Then slide it into position, attach the coaxial line between the matching ring and the radial ring. Coat the outside of the aluminum connector threads and the PL-259 with silicone grease provided. Do not coat the connector center pin and socket with silicone. Slide the vinyl boots over the connectors and against the plate for a good weather-tight connection. Follow the same procedure for your 50 ohm coaxial feed cable and be sure to slide the vinyl boot over the cable before attaching the PL-259 connector. Tighten the radials snugly and evenly to the mast. DO NOT OVER TIGHTEN. Over tightening may cause perminent unwarranteed damage. (See Steps 1 and 2.)

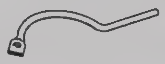
Tuning

Mount the antenna clear of surrounding objects. Keep all metal obstructions such as guy wires and other antennas at least 25 feet away. Attach a good quality VSWR bridge in the coaxial cable as close to the antenna as possible and note the VSWR at your frequency. For the ARX-2B and ARX-220B move the tuning rod for lowest VSWR. For the ARX-450B adjust the length of the lower section for minimum VSWR.

PARTS LIST ARX-450B

	DISPLAY	DESC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY w/ RING		1
LL		PHASING STUB ASSEMBLY	3/8″ x 28 3/4″ (0.9 x 73.0 cm)	1
KK		RADIAL RING ASSEMBLY		1
JJ		ALUM. RADIAL ROD	1/4″ x 6 3/4″ (0.64 x 17.1 cm)	3
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	17″ (43.1 cm)	1

PARTS PACKAGE ARX-2B, ARX-220B

P/N	DETAIL	DESC.	SIZE	QTY.
9		MACHINE SCREW	8-32 x 5/8″ (1.6 cm)	2
10		INTERNAL TOOTH WASHER	#8	3
11		HEX NUT	#8-32	4
81		MACHINE SCREW	1/4″ - 20 x 3/4 (1.9 cm)	1
67		TUNING ROD CLAMP		1
77		PLASTIC CAP	3/8″ (0.9 cm)	1
94		LOCK NUT	1/4″ - 20 (.64 cm)	1
96		MACHINE SCREW	#8-32 x 3/8″ (0.9 cm)	2
97		FORMED TUNING ROD	3/16″ x 5″ (0.48 x 12.7 cm	1
G-6		TELESCOPE CLAMP	1/2″ (1.3 cm)	1
G-7		TELESCOPE CLAMP	5/8″ (1.6 cm)	1
G-8		TELESCOPE CLAMP	3/4″ (1.91 cm)	1
85		HEX NUT	1/4″ - 20 (0.64 cm)	3
84		LOCK WASHER	1/4″ (0.64 cm)	3

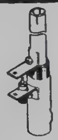
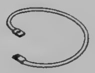
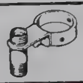
PARTS PACKAGE ARX-450B

P/N	DISPLAY	DESC.	SIZE	QTY.
85		HEX NUT	1/4″ - 20 (0.64 cm)	3
84		LOCK WASHER	1/4″ (0.64 cm)	3
155		LOCKING RING		1
80		MACHINE SCREW	8-32 x 1/2″ (1.6 cm)	1
11		8-32 HEX NUT		
GS-4 SS		WORM CLAMP		

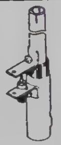
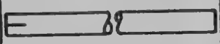
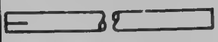
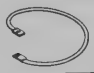
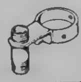
CHART A

Freq. MHz	Dimension A	Dimension B	Dimension C
ARX-2B			
135	59 1/2" (1.51 m)	54 1/2" (1.38 m)	9 3/4" (24.8 cm)
137	58 3/4" (1.49 m)	53 3/4" (1.36 m)	9 1/2" (24.1 cm)
140	57 1/2" (1.46 m)	52 1/2" (1.33 m)	9 1/4" (23.5 cm)
142	56 3/4" (1.44 m)	51 3/4" (1.31 m)	9 1/8" (23.2 cm)
145	55 1/2" (1.41 m)	50 1/2" (1.28 m)	9" (22.9 cm)
146	55 1/8" (1.40 m)	50 1/8" (1.27 m)	8 9/16" (22.7 cm)
147	54 3/4" (1.39 m)	49 3/4" (1.26 m)	8 7/8" (22.5 cm)
150	53 1/2" (1.36 m)	48 3/4" (1.24 m)	8 3/4" (22.2 cm)
152	52 3/4" (1.34 m)	48" (1.22 m)	8 5/8" (21.9 cm)
155	51 3/4" (1.31 m)	47" (1.19 m)	8 1/2" (21.6 cm)
157	51" (1.29 m)	46 1/4" (1.17 m)	8 3/8" (21.3 cm)
160	50" (1.27 m)	45 1/2" (1.16 m)	8 1/4" (21.0 cm)
ARX-220B			
220-225	33 1/8" (84.1 cm)	32" (81.3 cm)	5 3/4" (14.6 cm)
ARX-450B			
435-450	17" (43.2 cm)	NONE	3" (7.6 cm)
450-470	16 1/2" (41.9 cm)	NONE	2 7/8" (7.3 cm)

PARTS LIST ARX-2B

P/N	DISPLAY	DISC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY		✗ 1
BB		ALUM. TUBING	5/8" x 15" (1.6 x 38.1 cm)	1 ✗
CC		ALUM. TUBING	1/2" x 21" (1.3 x 53.3 cm)	1 ✗
DD		ALUM. TUBING w/ INSULATOR	1/2" x 24" (1.3 x 70 cm)	1 ✗
EE		ALUM. TUBING	3/8" x 35" (0.9 x 88.9 cm)	1 ✗
FF		ALUM. PHASING STUB	10 1/2" (26.6 cm)	✗ 1
GG		ROD BASE RING	5" ROUND x 1/4" (12.7 x 0.64 cm)	1 ✗
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	50 1/2" (127.2 cm)	✗ 1
JJ		ALUM. RADIAL RODS	1/4" x 20 1/2" (0.64 x 52.1 cm)	3 ✗
KK		RADIAL RING ASSEMBLY		✗ 1

PARTS LIST ARX-220B

P/N	DETAIL	DESC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY		1
BB		ALUM. TUBING	5/8" x 15" (1.59 x 38.1 cm)	1
CC		ALUM. TUBING	1/2" x 12" (1.2 x 30.5 cm)	1
DD		ALUM. TUBING w/ INSULATOR	1/2" x 12" (1.2 x 30.5 cm)	1
EE		ALUM. TUBING	3/8" x 24" (0.9 x 61 cm)	1
FF		ALUM. PHASING STUB	6 3/4" (17.1 cm)	1
GG		ROD BASE RING	5" ROUND x 1/4" (12.7 x 0.64 cm)	1
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	33" (83.8 cm)	1
JJ		ALUM. RADIAL RODS	1/4" x 13 1/4" (0.64 x 33.7 cm)	3
KK		RADIAL RING ASSEMBLY		1

ARX-2B, ARX-220B

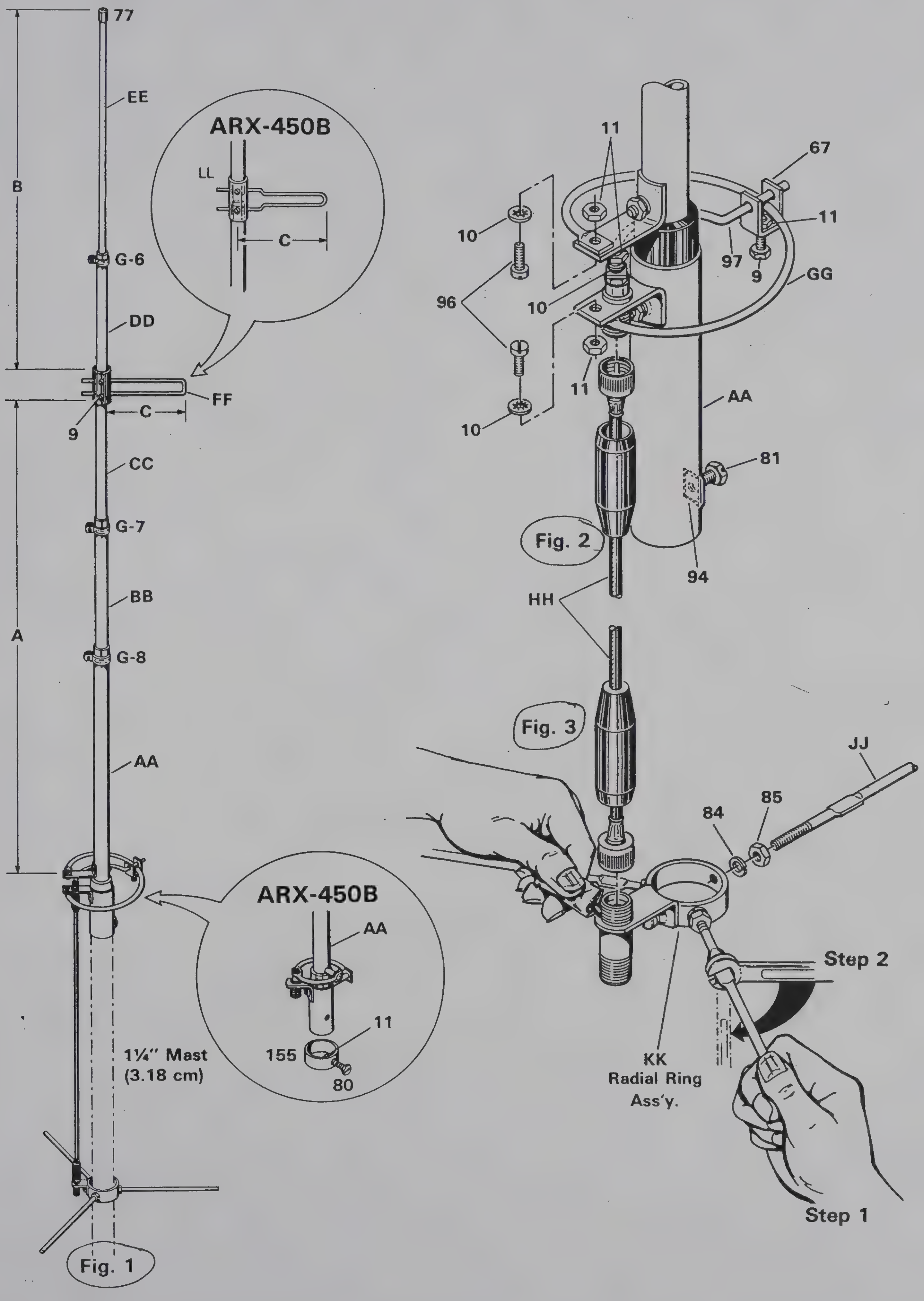


Fig. 1

Fig. 2

Fig. 3

LIMITED WARRANTY

CUSHCRAFT CORPORATION, P.O. BOX 4680, MANCHESTER, NEW HAMPSHIRE 03108, WARRANTS TO THE ORIGINAL CONSUMER PURCHASER FOR ONE YEAR FROM DATE OF PURCHASE THAT EACH CUSHCRAFT ANTENNA IS FREE OF DEFECTS IN MATERIAL OR WORKMANSHIP. IF, IN THE JUDGEMENT OF CUSHCRAFT, ANY SUCH ANTENNA IS DEFECTIVE, THEN CUSHCRAFT CORPORATION WILL, AT ITS OPTION, REPAIR OR REPLACE THE ANTENNA AT ITS EXPENSE WITHIN THIRTY DAYS OF THE DATE THE ANTENNA IS RETURNED (AT PURCHASER'S EXPENSE) TO CUSHCRAFT OR ONE OF ITS AUTHORIZED REPRESENTATIVES. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESSED WARRANTIES, ANY IMPLIED WARRANTY IS LIMITED IN DURATION TO ONE YEAR. CUSHCRAFT CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM A DEFECT. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR EXCLUSIONS OR LIMITATIONS OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION AND EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. THIS WARRANTY DOES NOT EXTEND TO ANY PRODUCTS WHICH HAVE BEEN SUBJECT TO MISUSE, NEGLECT, ACCIDENT OR IMPROPER INSTALLATION. ANY REPAIRS OR ALTERATIONS OUTSIDE OF THE CUSHCRAFT FACTORY WILL NULIFY THIS WARRANTY.

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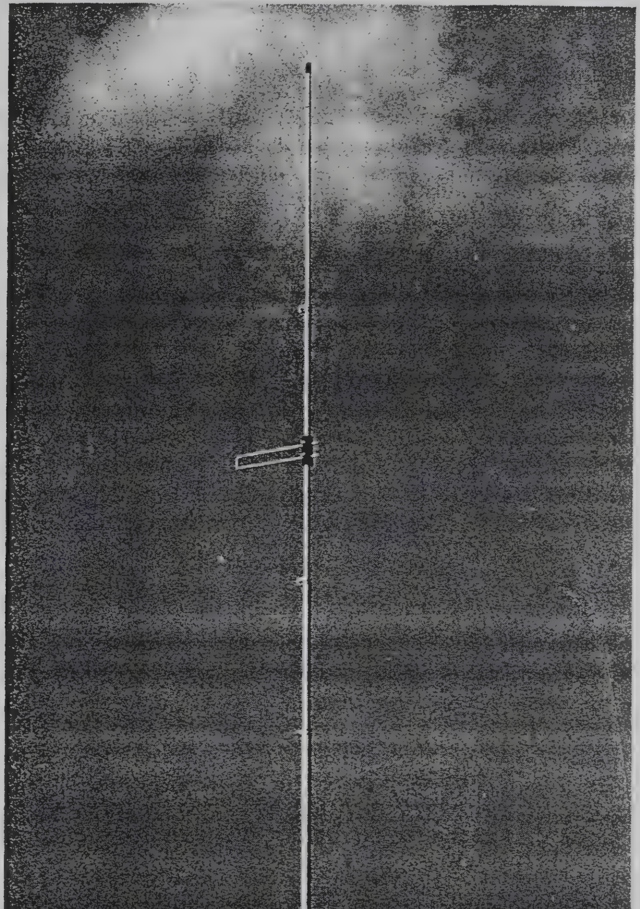
P.O. BOX 4680, MANCHESTER, N.H. 03108

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

ASSEMBLY AND INSTALLATION INSTRUCTIONS

ARX-2B,
ARX-220B,
and ARX-450B

Ringo Ranger II Antenna



cushcraft
CORPORATION

A100880

Your Cushcraft Ringo Ranger II is designed and manufactured to give top performance and trouble free service. The antenna will perform as specified if the instructions and suggestions are followed and care is used in assembly and installation.

Masting

The ARX-2B and ARX-220B will take up to a 1⅜" (3.5 cm) OD mast. For most installations a 1¼" (3.2 cm) OD TV type mast will be satisfactory. The ARX-450B will take up to a 1" (2.5 cm) OD mast. A total of 55" (139.7 cm) of exposed mast is necessary to install the ARX-2B. The ARX-220B requires 38" (91.4 cm) and the ARX-450B needs 20" (50.8 cm).

Location

Location of the antenna is very important. Surrounding objects such as trees, power lines, other antennas, etc. will seriously reduce efficiency. To minimize the effects of surrounding objects, mount the antenna as high and in the clear as possible. If metal guy wires are used, they should be broken with strain insulators. WARNING: THIS ANTENNA IS AN ELECTRICAL CONDUCTOR, CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. FOLLOW THE GUIDELINES FOR ANTENNA INSTALLATIONS RECOMMENDED BY THE U.S. CONSUMER PRODUCT SAFETY COMMISSION AND LISTED IN THE ENCLOSED PAMPHLET.

Mounting

Several antennas may be mounted on the same mast. Your Ringo Ranger II may be mounted on the top of a beam antenna. When side mounting your Ringo Ranger II on a tower, it should be kept at least ¼ wavelength out from the tower.

Antenna Assembly

Attach the matching ring as shown in figure 2. Assemble the tuning rod clamp, place it over the tuning ring and slide the tuning rod through it. Attach the flattened end of the coax connector. Be sure the tuning rod is on the proper side of the base.

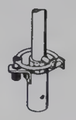
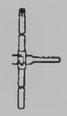
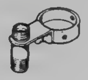
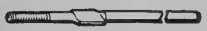
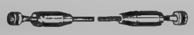
Using figure 1 assemble the radiating section. Adjust dimensions A, B, and C using chart A. Tighten all fasteners snugly.

Assemble the radial ring as shown in figure 3. Then slide it into position, attach the coaxial line between the matching ring and the radial ring. Coat the outside of the aluminum connector threads and the PL-259 with silicone grease provided. Do not coat the connector center pin and socket with silicone. Slide the vinyl boots over the connectors and against the plate for a good weather-tight connection. Follow the same procedure for your 50 ohm coaxial feed cable and be sure to slide the vinyl boot over the cable before attaching the PL-259 connector. Tighten the radials snugly and evenly to the mast. DO NOT OVER TIGHTEN. Over tightening may cause perminent unwarranteed damage. (See Steps 1 and 2.)

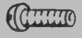
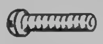
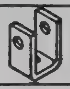
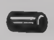
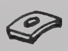
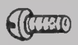
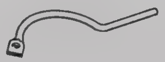
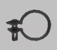
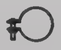
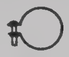
Tuning

Mount the antenna clear of surrounding objects. Keep all metal obstructions such as guy wires and other antennas at least 25 feet away. Attach a good quality VSWR bridge in the coaxial cable as close to the antenna as possible and note the VSWR at your frequency. For the ARX-2B and ARX-220B move the tuning rod for lowest VSWR. For the ARX-450B adjust the length of the lower section for minimum VSWR.

PARTS LIST ARX-450B

	DISPLAY	DESC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY w/ RING		1
LL		PHASING STUB ASSEMBLY	3/8″ x 28 3/4″ (0.9 x 73.0 cm)	1
KK		RADIAL RING ASSEMBLY		1
JJ		ALUM. RADIAL ROD	1/4″ x 6 3/4″ (0.64 x 17.1 cm)	3
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	17″ (43.1 cm)	1

PARTS PACKAGE ARX-2B, ARX-220B

P/N	DETAIL	DESC.	SIZE	QTY.
9		MACHINE SCREW	8-32 x 5/8″ (1.6 cm)	2
10		INTERNAL TOOTH WASHER	#8	3
11		HEX NUT	#8-32	4
81		MACHINE SCREW	1/4″ - 20 x 3/4 (1.9 cm)	1
67		TUNING ROD CLAMP		1
77		PLASTIC CAP	3/8″ (0.9 cm)	1
94		LOCK NUT	1/4″ - 20 (.64 cm)	1
96		MACHINE SCREW	#8-32 x 3/8″ (0.9 cm)	2
97		FORMED TUNING ROD	3/16″ x 5″ (0.48 x 12.7 cm	1
G-6		TELESCOPE CLAMP	1/2″ (1.3 cm)	1
G-7		TELESCOPE CLAMP	5/8″ (1.6 cm)	1
G-8		TELESCOPE CLAMP	3/4″ (1.91 cm)	1
85		HEX NUT	1/4″ - 20 (0.64 cm)	3
84		LOCK WASHER	1/4″ (0.64 cm)	3

PARTS PACKAGE ARX-450B

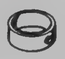
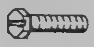
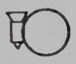
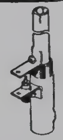
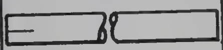
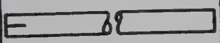
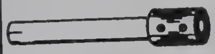
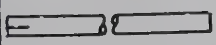
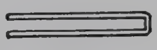
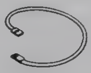
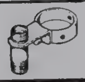
P/N	DISPLAY	DESC.	SIZE	QTY.
85		HEX NUT	1/4″ - 20 (0.64 cm)	3
84		LOCK WASHER	1/4″ (0.64 cm)	3
155		LOCKING RING		1
80		MACHINE SCREW	8-32 x 1/2″ (1.6 cm)	1
11		8-32 HEX NUT		
GS-4 SS		WORM CLAMP		

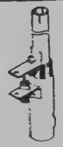
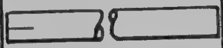
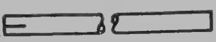
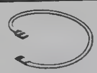
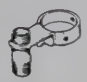
CHART A

Freq. MHz	Dimension A	Dimension B	Dimension C
ARX-2B			
135	59 1/2" (1.51 m)	54 1/2" (1.38 m)	9 3/4" (24.8 cm)
137	58 3/4" (1.49 m)	53 3/4" (1.36 m)	9 1/2" (24.1 cm)
140	57 1/2" (1.46 m)	52 1/2" (1.33 m)	9 1/4" (23.5 cm)
142	56 3/4" (1.44 m)	51 3/4" (1.31 m)	9 1/8" (23.2 cm)
145	55 1/2" (1.41 m)	50 1/2" (1.28 m)	9" (22.9 cm)
146	55 1/8" (1.40 m)	50 1/8" (1.27 m)	8 9/16" (22.7 cm)
147	54 3/4" (1.39 m)	49 3/4" (1.26 m)	8 7/8" (22.5 cm)
150	53 1/2" (1.36 m)	48 3/4" (1.24 m)	8 3/4" (22.2 cm)
152	52 3/4" (1.34 m)	48" (1.22 m)	8 5/8" (21.9 cm)
155	51 3/4" (1.31 m)	47" (1.19 m)	8 1/2" (21.6 cm)
157	51" (1.29 m)	46 1/4" (1.17 m)	8 3/8" (21.3 cm)
160	50" (1.27 m)	45 1/2" (1.16 m)	8 1/4" (21.0 cm)
ARX-220B			
220-225	33 1/8" (84.1 cm)	32" (81.3 cm)	5 3/4" (14.6 cm)
ARX-450B			
435-450	17" (43.2 cm)	NONE	3" (7.6 cm)
450-470	16 1/2" (41.9 cm)	NONE	2 7/8" (7.3 cm)

PARTS LIST ARX-2B

P/N	DISPLAY	DISC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY		✗ 1
BB		ALUM. TUBING	5/8" x 15" (1.6 x 38.1 cm)	1✗
CC		ALUM. TUBING	1/2" x 21" (1.3 x 53.3 cm)	1✗
DD		ALUM. TUBING w/ INSULATOR	1/2" x 24" (1.3 x 70 cm)	1✗
EE		ALUM. TUBING	3/8" x 35" (0.9 x 88.9 cm)	1✗
FF		ALUM. PHASING STUB	10 1/2" (26.6 cm)	✗ 1
GG		ROD BASE RING	5" ROUND x 1/4" (12.7 x 0.64 cm)	✗ 1
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	50 1/2" (127.2 cm)	✗ 1
JJ		ALUM. RADIAL RODS	1/4" x 20 1/2" (0.64 x 52.1 cm)	3✗
KK		RADIAL RING ASSEMBLY		✗ 1

PARTS LIST ARX-220B

P/N	DETAIL	DESC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY		1
BB		ALUM. TUBING	5/8" x 15" (1.59 x 38.1 cm)	1
CC		ALUM. TUBING	1/2" x 12" (1.2 x 30.5 cm)	1
DD		ALUM. TUBING w/ INSULATOR	1/2" x 12" (1.2 x 30.5 cm)	1
EE		ALUM. TUBING	3/8" x 24" (0.9 x 61 cm)	1
FF		ALUM. PHASING STUB	6 3/4" (17.1 cm)	1
GG		ROD BASE RING	5" ROUND x 1/4" (12.7 x 0.64 cm)	1
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	33" (83.8 cm)	1
JJ		ALUM. RADIAL RODS	1/4" x 13 1/4" (0.64 x 33.7 cm)	3
KK		RADIAL RING ASSEMBLY		1

ARX-2B, ARX-220B

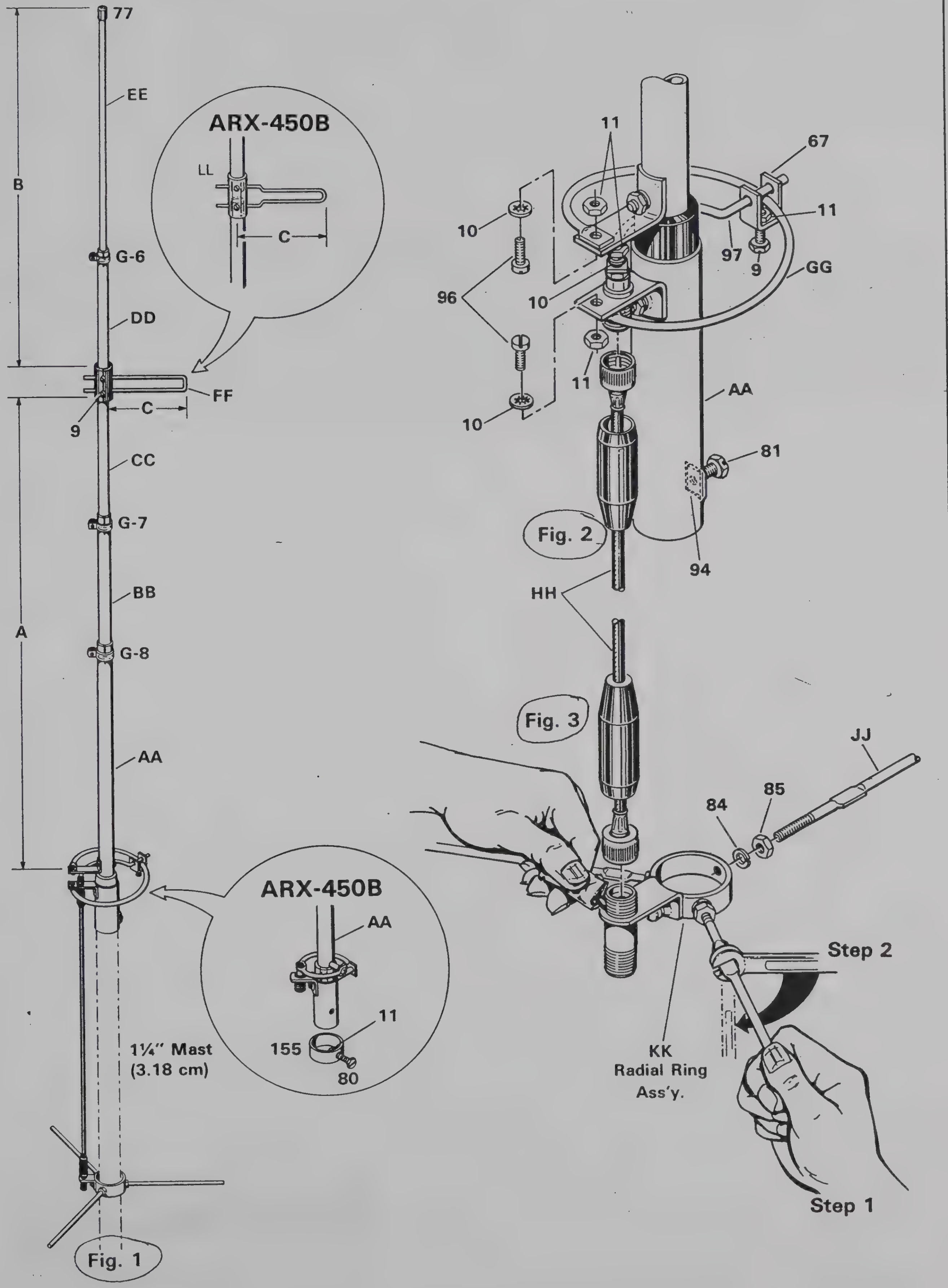


Fig. 1

Fig. 2

Fig. 3

LIMITED WARRANTY

CUSHCRAFT CORPORATION, P.O. BOX 4680, MANCHESTER, NEW HAMPSHIRE 03108, WARRANTS TO THE ORIGINAL CONSUMER PURCHASER FOR ONE YEAR FROM DATE OF PURCHASE THAT EACH CUSHCRAFT ANTENNA IS FREE OF DEFECTS IN MATERIAL OR WORKMANSHIP. IF, IN THE JUDGEMENT OF CUSHCRAFT, ANY SUCH ANTENNA IS DEFECTIVE, THEN CUSHCRAFT CORPORATION WILL, AT ITS OPTION, REPAIR OR REPLACE THE ANTENNA AT ITS EXPENSE WITHIN THIRTY DAYS OF THE DATE THE ANTENNA IS RETURNED (AT PURCHASER'S EXPENSE) TO CUSHCRAFT OR ONE OF ITS AUTHORIZED REPRESENTATIVES. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESSED WARRANTIES, ANY IMPLIED WARRANTY IS LIMITED IN DURATION TO ONE YEAR. CUSHCRAFT CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM A DEFECT. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR EXCLUSIONS OR LIMITATIONS OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION AND EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. THIS WARRANTY DOES NOT EXTEND TO ANY PRODUCTS WHICH HAVE BEEN SUBJECT TO MISUSE, NEGLECT, ACCIDENT OR IMPROPER INSTALLATION. ANY REPAIRS OR ALTERATIONS OUTSIDE OF THE CUSHCRAFT FACTORY WILL NULIFY THIS WARRANTY.

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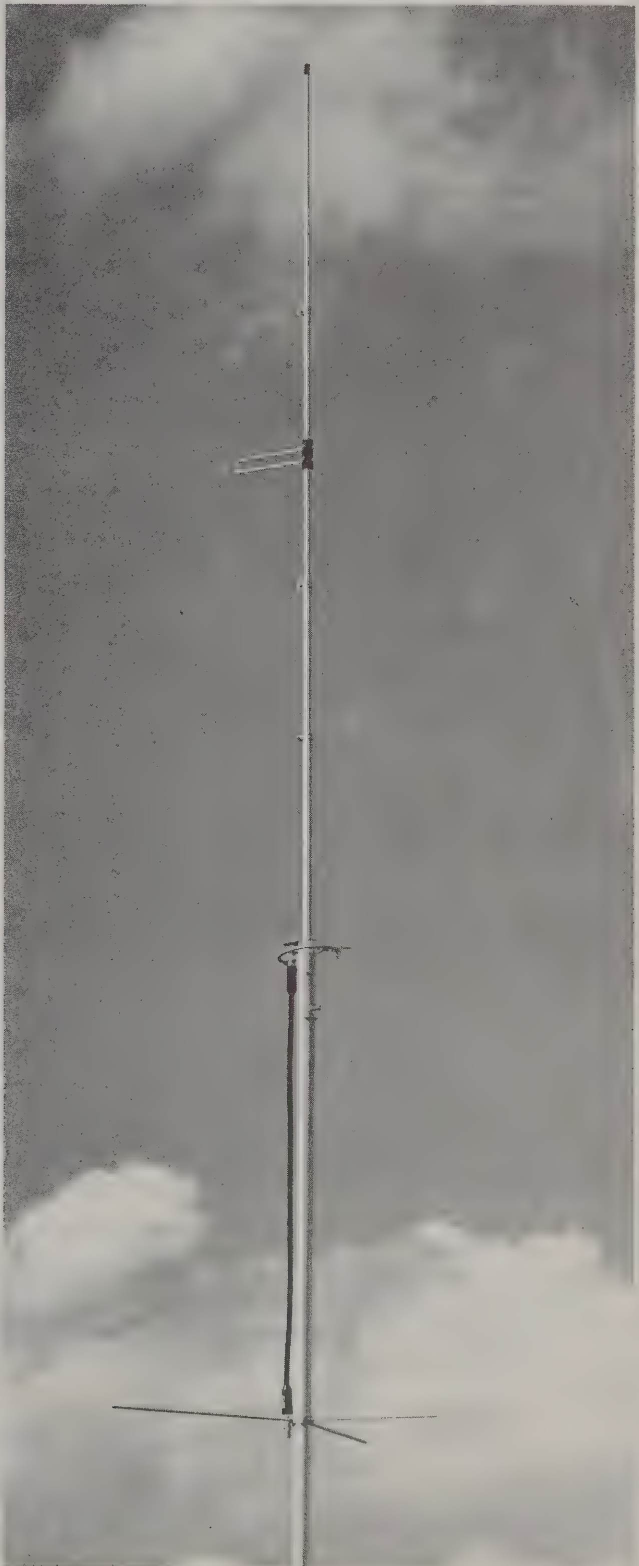
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

ASSEMBLY AND INSTALLATION INSTRUCTIONS

ARX-2B, ARX-220B, and ARX-450B

Ringo Ranger II Antenna



cushcraft
CORPORATION

A100880

Your Cushcraft Ringo Ranger II is designed and manufactured to give top performance and trouble free service. The antenna will perform as specified if the instructions and suggestions are followed and care is used in assembly and installation.

Masting

The ARX-2B and ARX-220B will take up to a 1⅜" (3.5 cm) OD mast. For most installations a 1¼" (3.2 cm) OD TV type mast will be satisfactory. The ARX-450B will take up to a 1" (2.5 cm) OD mast. A total of 55" (139.7 cm) of exposed mast is necessary to install the ARX-2B. The ARX-220B requires 38" (91.4 cm) and the ARX-450B needs 20" (50.8 cm).

Location

Location of the antenna is very important. Surrounding objects such as trees, power lines, other antennas, etc. will seriously reduce efficiency. To minimize the effects of surrounding objects, mount the antenna as high and in the clear as possible. If metal guy wires are used, they should be broken with strain insulators. WARNING: THIS ANTENNA IS AN ELECTRICAL CONDUCTOR, CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. FOLLOW THE GUIDELINES FOR ANTENNA INSTALLATIONS RECOMMENDED BY THE U.S. CONSUMER PRODUCT SAFETY COMMISSION AND LISTED IN THE ENCLOSED PAMPHLET.

Mounting

Several antennas may be mounted on the same mast. Your Ringo Ranger II may be mounted on the top of a beam antenna. When side mounting your Ringo Ranger II on a tower, it should be kept at least ¼ wavelength out from the tower.

Antenna Assembly

Attach the matching ring as shown in figure 2. Assemble the tuning rod clamp, place it over the tuning ring and slide the tuning rod through it. Attach the flattened end of the coax connector. Be sure the tuning rod is on the proper side of the base.

Using figure 1 assemble the radiating section. Adjust dimensions A, B, and C using chart A. Tighten all fasteners snugly.

Assemble the radial ring as shown in figure 3. Then slide it into position, attach the coaxial line between the matching ring and the radial ring. Coat the outside of the aluminum connector threads and the PL-259 with silicone grease provided. Do not coat the connector center pin and socket with silicone. Slide the vinyl boots over the connectors and against the plate for a good weather-tight connection. Follow the same procedure for your 50 ohm coaxial feed cable and be sure to slide the vinyl boot over the cable before attaching the PL-259 connector. Tighten the radials snugly and evenly to the mast. DO NOT OVER TIGHTEN. Over tightening may cause perminent unwarranteed damage. (See Steps 1 and 2.)

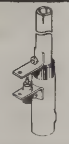
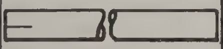
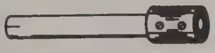
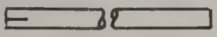
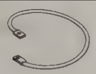
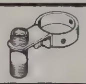
Tuning

Mount the antenna clear of surrounding objects. Keep all metal obstructions such as guy wires and other antennas at least 25 feet away. Attach a good quality VSWR bridge in the coaxial cable as close to the antenna as possible and note the VSWR at your frequency. For the ARX-2B and ARX-220B move the tuning rod for lowest VSWR. For the ARX-450B adjust the length of the lower section for minimum VSWR.

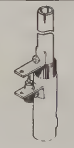
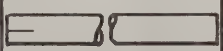
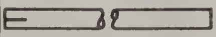
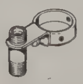
CHART A

Freq. MHz	Dimension A	Dimension B	Dimension C
ARX-2B			
135	59 1/2″ (1.51 m)	54 1/2″ (1.38 m)	9 3/4″ (24.8 cm)
137	58 3/4″ (1.49 m)	53 3/4″ (1.36 m)	9 1/2″ (24.1 cm)
140	57 1/2″ (1.46 m)	52 1/2″ (1.33 m)	9 1/4″ (23.5 cm)
142	56 3/4″ (1.44 m)	51 3/4″ (1.31 m)	9 1/8″ (23.2 cm)
145	55 1/2″ (1.41 m)	50 1/2″ (1.28 m)	9″ (22.9 cm)
~~146~~	~~55 1/8″ (1.40 m)~~	~~50 1/8″ (1.27 m)~~	~~8 9/16″ (22.7 cm)~~
147	54 3/4″ (1.39 m)	49 3/4″ (1.26 m)	8 7/8″ (22.5 cm)
150	53 1/2″ (1.36 m)	48 3/4″ (1.24 m)	8 3/4″ (22.2 cm)
152	52 3/4″ (1.34 m)	48″ (1.22 m)	8 5/8″ (21.9 cm)
155	51 3/4″ (1.31 m)	47″ (1.19 m)	8 1/2″ (21.6 cm)
157	51″ (1.29 m)	46 1/4″ (1.17 m)	8 3/8″ (21.3 cm)
160	50″ (1.27 m)	45 1/2″ (1.16 m)	8 1/4″ (21.0 cm)
ARX-220B			
220-225	33 1/8″ (84.1 cm)	32″ (81.3 cm)	5 3/4″ (14.6 cm)
ARX-450B			
435-450	17″ (43.2 cm)	NONE	3″ (7.6 cm)
450-470	16 1/2″ (41.9 cm)	NONE	2 7/8″ (7.3 cm)

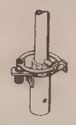
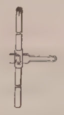
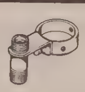
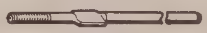
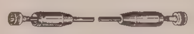
PARTS LIST ARX-2B

P/N	DISPLAY	DISC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY		✗ 1
BB		ALUM. TUBING	5/8″ x 15″ (1.6 x 38.1 cm)	1 ✗
CC		ALUM. TUBING	1/2″ x 21″ (1.3 x 53.3 cm)	1 ✗
DD		ALUM. TUBING w/ INSULATOR	1/2″ x 24″ (1.3 x 70 cm)	1 ✗
EE		ALUM. TUBING	3/8″ x 35″ (0.9 x 88.9 cm)	1 ✗
FF		ALUM. PHASING STUB	10 1/2″ (26.6 cm)	✗ 1
GG		ROD BASE RING	5″ROUND x 1/4″ (12.7 x 0.64 cm)	1 ✗
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	50 1/2″ (127.2 cm)	✗ 1
JJ		ALUM. RADIAL RODS	1/4″ x 20 1/2″ (0.64 x 52.1 cm)	3 ✗
KK		RADIAL RING ASSEMBLY		✗ 1

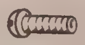
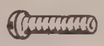
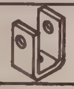
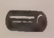
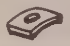
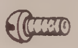
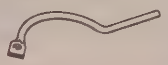
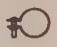
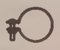
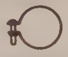
PARTS LIST ARX-220B

P/N	DETAIL	DESC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY		1
BB		ALUM. TUBING	5/8″ x 15″ (1.59 x 38.1 cm)	1
CC		ALUM. TUBING	1/2″ x 12″ (1.2 x 30.5 cm)	1
DD		ALUM. TUBING w/ INSULATOR	1/2″ x 12″ (1.2 x 30.5 cm)	1
EE		ALUM. TUBING	3/8″ x 24″ (0.9 x 61 cm)	1
FF		ALUM. PHASING STUB	6 3/4″ (17.1 cm)	1
GG		ROD BASE RING	5″ ROUND x 1/4″ (12.7 x 0.64 cm)	1
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	33″ (83.8 cm)	1
JJ		ALUM. RADIAL RODS	1/4″ x 13 1/4″ (0.64 x 33.7 cm)	3
KK		RADIAL RING ASSEMBLY		1

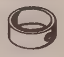
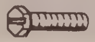
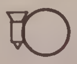
PARTS LIST ARX-450B

	DISPLAY	DESC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY w/ RING		1
LL		PHASING STUB ASSEMBLY	3/8" x 28 3/4" (0.9 x 73.0 cm)	1
KK		RADIAL RING ASSEMBLY		1
JJ		ALUM. RADIAL ROD	1/4" x 6 3/4" (0.64 x 17.1 cm)	3
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	17" (43.1 cm)	1

PARTS PACKAGE ARX-2B, ARX-220B

P/N	DETAIL	DESC.	SIZE	QTY.
9		MACHINE SCREW	8-32 x 5/8" (1.6 cm)	2
10		INTERNAL TOOTH WASHER	#8	3
11		HEX NUT	#8-32	4
81		MACHINE SCREW	1/4" - 20 x 3/4 (1.9 cm)	1
67		TUNING ROD CLAMP		1
77		PLASTIC CAP	3/8" (0.9 cm)	1
94		LOCK NUT	1/4" - 20 (.64 cm)	1
96		MACHINE SCREW	#8-32 x 3/8" (0.9 cm)	2
97		FORMED TUNING ROD	3/16" x 5" (0.48 x 12.7 cm	1
G-6		TELESCOPE CLAMP	1/2" (1.3 cm)	1
G-7		TELESCOPE CLAMP	5/8" (1.6 cm)	1
G-8		TELESCOPE CLAMP	3/4" (1.91 cm)	1
85		HEX NUT	1/4" - 20 (0.64 cm)	3
84		LOCK WASHER	1/4" (0.64 cm)	3

PARTS PACKAGE ARX-450B

P/N	DISPLAY	DESC.	SIZE	QTY.
85		HEX NUT	1/4" - 20 (0.64 cm)	3
84		LOCK WASHER	1/4" (0.64 cm)	3
155		LOCKING RING		1
80		MACHINE SCREW	8-32 x 1/2" (1.6 cm)	1
11		8-32 HEX NUT		
GS-4 SS		WORM CLAMP		

ARX-2B, ARX-220B

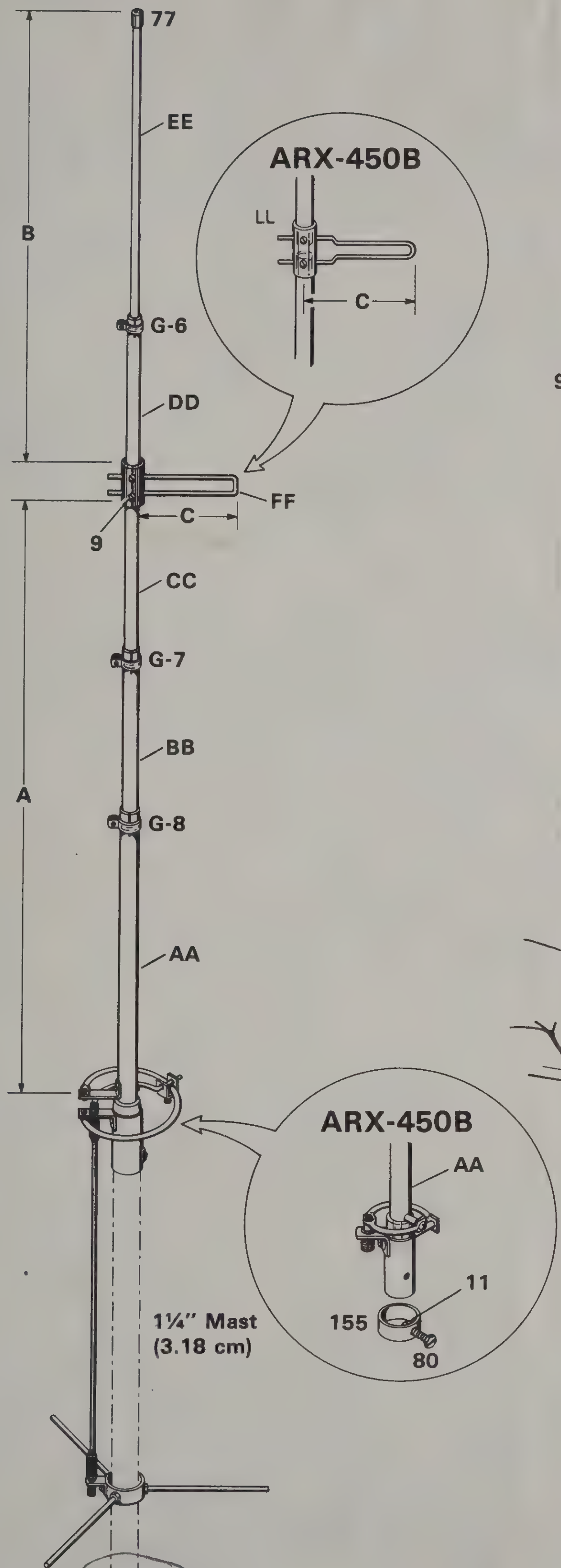


Fig. 1

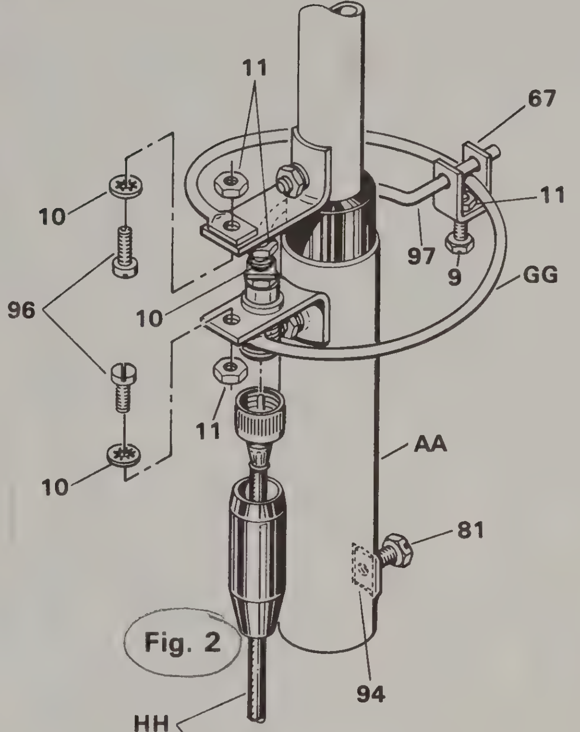


Fig. 2

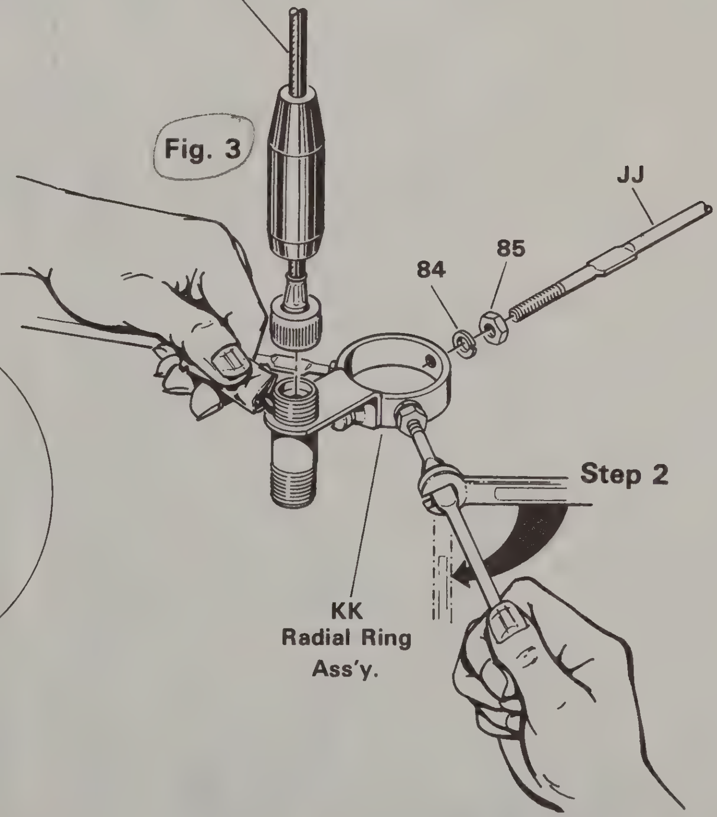


Fig. 3

LIMITED WARRANTY

CUSHCRAFT CORPORATION, P.O. BOX 4680, MANCHESTER, NEW HAMPSHIRE 03108, WARRANTS TO THE ORIGINAL CONSUMER PURCHASER FOR ONE YEAR FROM DATE OF PURCHASE THAT EACH CUSHCRAFT ANTENNA IS FREE OF DEFECTS IN MATERIAL OR WORKMANSHIP. IF, IN THE JUDGEMENT OF CUSHCRAFT, ANY SUCH ANTENNA IS DEFECTIVE, THEN CUSHCRAFT CORPORATION WILL, AT ITS OPTION, REPAIR OR REPLACE THE ANTENNA AT ITS EXPENSE WITHIN THIRTY DAYS OF THE DATE THE ANTENNA IS RETURNED (AT PURCHASER'S EXPENSE) TO CUSHCRAFT OR ONE OF ITS AUTHORIZED REPRESENTATIVES. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESSED WARRANTIES, ANY IMPLIED WARRANTY IS LIMITED IN DURATION TO ONE YEAR. CUSHCRAFT CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM A DEFECT. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR EXCLUSIONS OR LIMITATIONS OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION AND EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. THIS WARRANTY DOES NOT EXTEND TO ANY PRODUCTS WHICH HAVE BEEN SUBJECT TO MISUSE, NEGLECT, ACCIDENT OR IMPROPER INSTALLATION. ANY REPAIRS OR ALTERATIONS OUTSIDE OF THE CUSHCRAFT FACTORY WILL NULIFY THIS WARRANTY.

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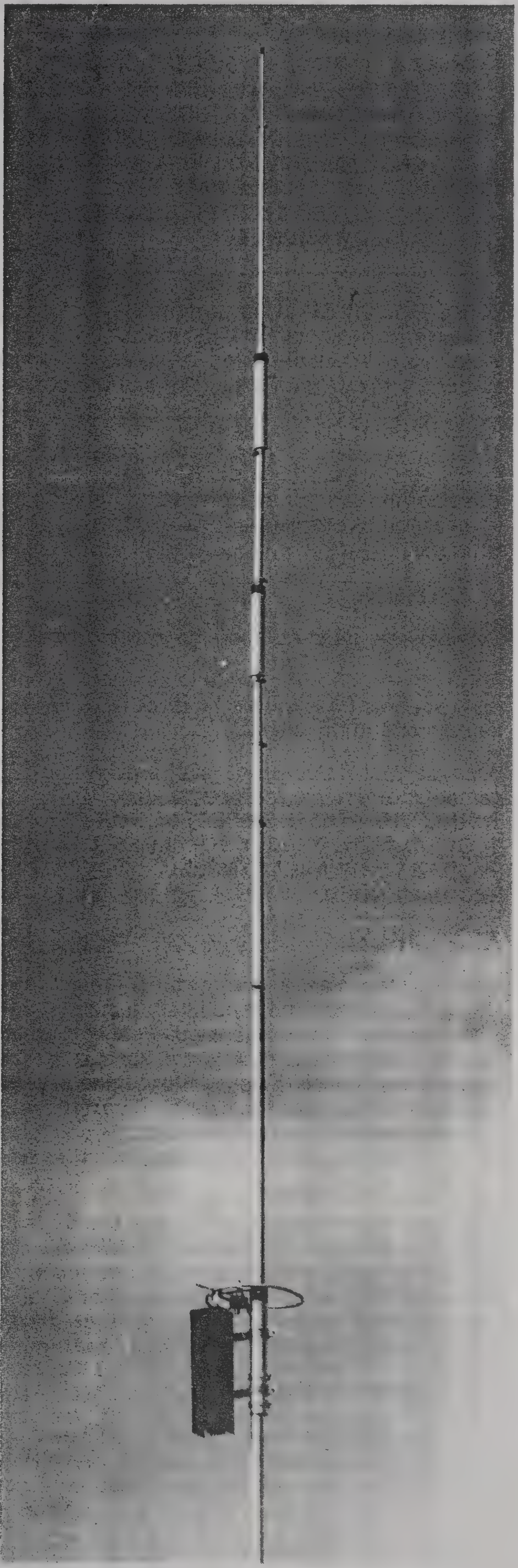
P.O. BOX 4680, MANCHESTER, N.H. 03108

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

ASSEMBLY & INSTALLATION INSTRUCTIONS



R3

10-15-20
METER ANTENNA

cushcraft
CORPORATION
THE ANTENNA COMPANY

AR3681

WARNING:
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Your Cushcraft R3 vertical antenna is designed and manufactured to give trouble free service. The antenna will perform as specified if the instructions and suggestions are followed and care is used in assembly and installation. When checking the tubing received with your antenna package using the parts list, it is easiest to identify the various dimensions of tubing by separating them by diameter.

PLANNING:

Plan your installation carefully. If you use volunteer helpers be sure that they are qualified to assist you. Make certain everyone involved understands that you are the boss and that they must follow your instructions. If you have any doubts at all, employ a professional antenna installation company to install your antenna.

LOCATION:

Extreme care must be used for your safety.

Although the R3 will operate in almost any location, it will perform best if it is in the clear. Surrounding objects such as trees, power lines, other antennas, etc., will reduce its efficiency. If possible mount the antenna high and in the clear.

Because your R3 does not require radials, it can be mounted in various locations. You roof top, balcony, garden, motor home roof, porch, deck, or tower top, etc., are all locations suitable for the R3. **YOUR MUST INSURE THAT NEITHER PEOPLE NOR PETS CAN COME IN CONTACT WITH YOUR ANTENNA WHILE IT IS IN OPERATION. DEADLY VOLTAGES AND CURRENTS MAY EXIST. ALSO, SINCE THE EFFECTS OF EXPOSURE TO RF ARE NOT FULLY UNDERSTOOD, LONG TERM EXPOSURE TO INTENSE RF FIELDS IS NOT RECOMMENDED.**

ASSEMBLY:

The first step in assembling your antenna is to assemble the ring section and matching network.
Using figure 1 as a guide, assemble the ring on the base section. Next mount the tuning rods and matching circuit in place using figure 2. Carefully measure the length as shown in figure 2D to find the location of the tuning rods. Tighten all nuts and bolts securely. Place mast mount ring clamp (90) on the base section per figure 3. Now place the capacitor tuning assembly clamps (188) around the base and loosely assemble the nuts and bolts. Place the capacitor box on the clamps and tighten the machine screws (79) securely. Now tighten the remaining hardware on the capacitor box clamps. Form strap (189) onto the CTA RF output terminal. This completes the assembly of the base section.

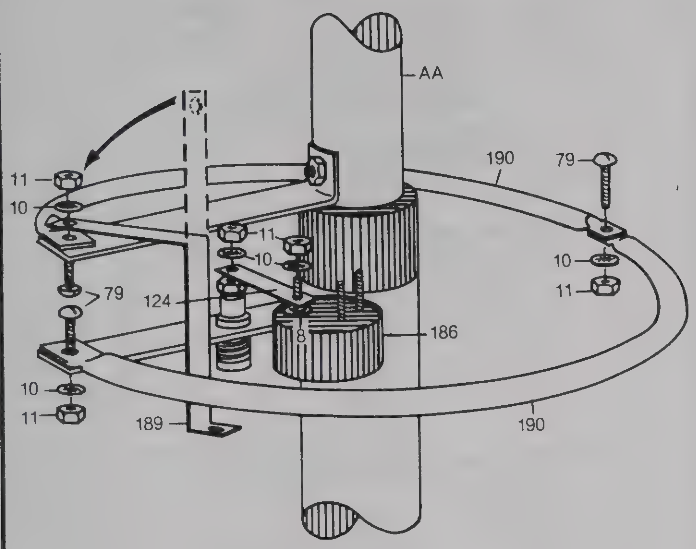
Begin assembly of the vertical radiator section with the 1-1/4" x 48" (3.2 x 121.9 cm) aluminum tubing. Place it and the other pieces in a line with the slotted ends all toward the top of the antenna. You will have three tubing sections below the first trap (TF), one tubing section between traps and two sections on the top. The remaining tubing sizes and lengths are shown in figure 1. The overlap between AA-AB, AB-AC, TR-CA will be 4" (1.6 cm). Other tubing overlaps will be determined by the overall lengths required. It is easiest to tighten the clamps as you assemble the radiator from bottom to top. Place the assembled radiator 4" (5.1 cm) into the base section and tighten the (S-10) clamps securely.

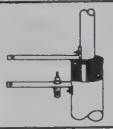
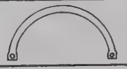
FEEDLINE ASSEMBLY:

The antenna is designed for use with 50 ohm coaxial cable terminated with a PL-259 connector. Any length of feedline can be used with your R3. The shortest length cable will have the least loss. A connector boot is included for use with your new antenna. To get the most out of it please follow these directions.

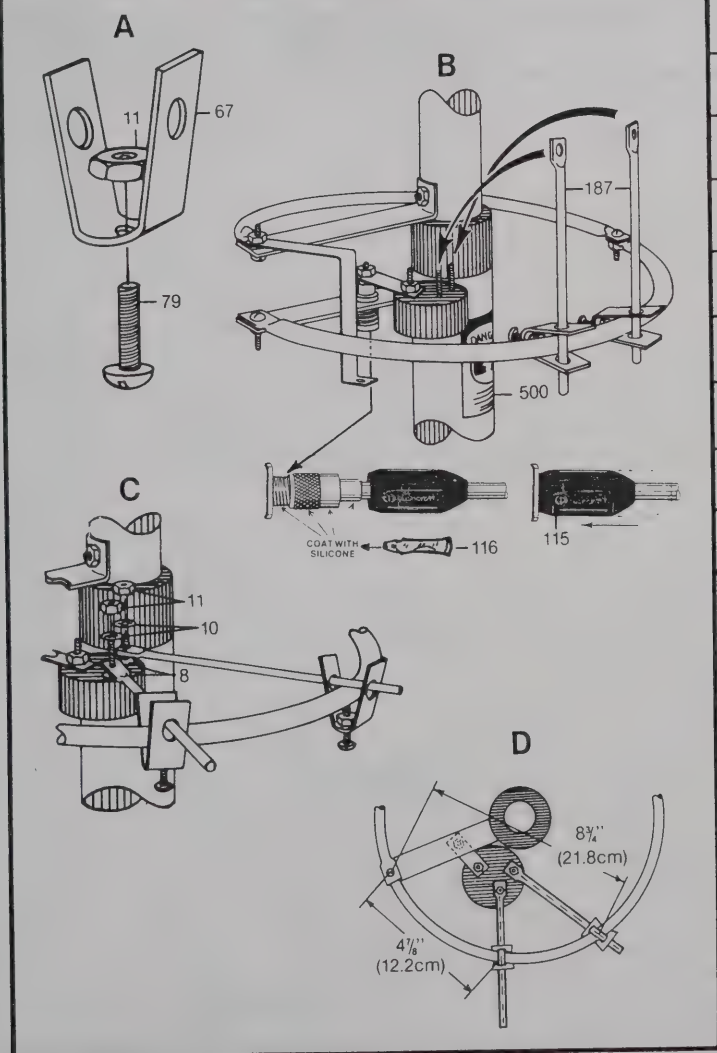
1. Insert the antenna end of your coax through the small end of the connector boot. RG-8/U is a very tight fit which results in an excellent weather seal. Attach the Pl-259 to your cable.

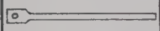
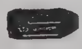
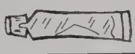
1 RING SECTION & MATCHING NETWORK ASSEMBLY



P/N	DETAIL	DESC.	SIZE	QTY.
AA		BASE SECTION	1⅜'' OD (33.3cm) x 48'' (121.9cm)	1
186		MATCHING NETWORK ASSEMBLY	2'' (5.08cm)	1
190		ALUMINUM RING SECTION	17'' x ⅜'' (43.2 x .95cm)	2
189		ALUMINUM CONNECTING STRAP	4⅞'' x ⅜'' (12.4 x .95cm)	1
124		ALUMINUM CONNECTOR STRAP	1½'' x 7/16'' (3.75 x 1.1cm)	1
79		SS R.H. MACHINE SCREW	#8-32 x ½'' (1.27cm)	3
10		SS INTERNAL TOOTH LOCK WASHER	#8	5
11		SS HEX NUT	#8-32	5
8		ALUMINUM FLAT WASHER	#8	1

2 TUNING ROD ASSEMBLY



P/N	DETAIL	DESC.	SIZE	QTY.
187		ALUMINUM STRAIGHT TUNING ROD	5½'' (13.97cm)	2
67		CR ALUMINUM TUNING ROD CLAMP		2
79		SS MACHINE SCREW	#8-32 x ½'' (1.3cm)	2
10		SS INTERNAL TOOTH LOCK WASHER	#8	2
11		SS HEX NUT	#8-32	4
8		ALUMINUM FLAT WASHER	#8	2
115		VINYL CONNECTOR BOOT	2'' (5.08cm)	1
116		SILICONE GREASE PACKET		1
500		DANGER LABEL		1

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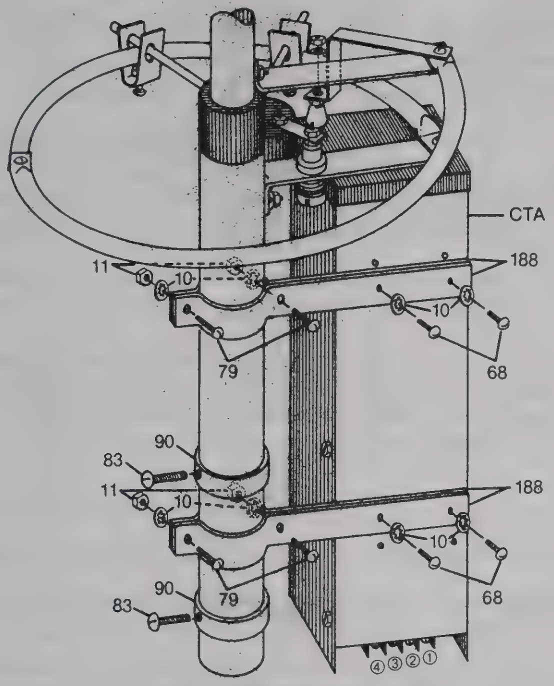
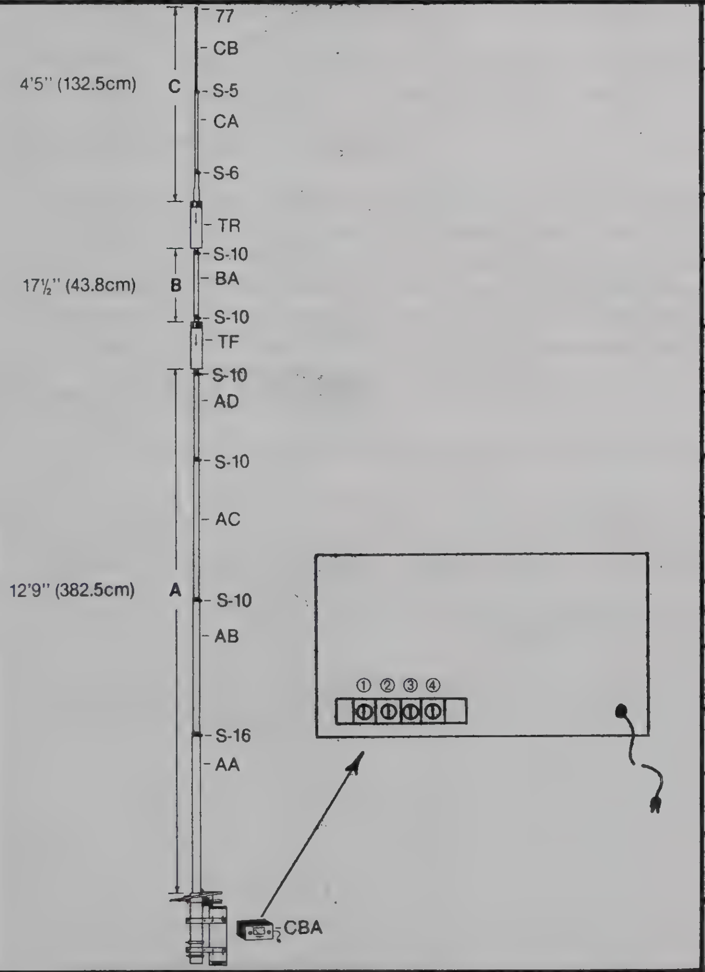
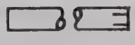
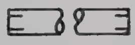
3 CAPACITOR TUNING ASSEMBLY



P/N	DETAIL	DESC.	SIZE	QTY.
CTA		CAPACITOR TUNING ASSEMBLY	3½" x 3½" x 12" (8.9 x 8.9 x 30.5cm)	1
188		FORMED ALUMINUM MOUNTING CLAMP	8" (20.3cm)	4
79		SS R.H. MACHINE SCREW	#8-32 x ½" (1.27cm)	4
10		SS INTERNAL TOOTH LOCK WASHER	#8	8
11		SS HEX NUT	#8-32	4
90		MAST MOUNT RING CLAMP		2
83		SS MACHINE SCREW	#¼-20 x 1¼" (3.18cm)	2
68		SS MACHINE SCREW	#8-32 x ⅜"(.95cm)	4

4 VERTICAL ASSEMBLY



P/N	DETAIL	DESC.	SIZE	QTY.
CBA		CONTROL BOX ASSEMBLY	4¼" x 6¼" x 3" (10.8 x 15.9 x 7.6cm)	1
S-16		SS WORM CLAMP	1¾"(4.4cm)	1
S-10		SS WORM CLAMP	1⅜" (3.5cm)	5
AB		ALUMINUM TUBING	1¼" x 48" (3.2 x 121.9cm) .058" Wall	1
AC		ALUMINUM TUBING	1⅛" x 48" (2.9 x 121.9cm) .058" Wall	1
AD		ALUMINUM TUBING	1" x 36" (2.5 x 91.4cm)	1
TF		10 METER TRAP	16⅝" (42.2cm)	1
BA		ALUMINUM TUBING	1" x 17" (2.5 x 43.2cm)	1
TR		15 METER TRAP	19" (48.3cm)	1
CA		ALUMINUM TUBING	½" x 36" (1.3 x 91.4cm)	1
CB		ALUMINUM TUBING	⅜" x 24" (.95 x 61.0cm)	1
77		BLACK PLASTIC CAP	⅜" (.95cm)	1
S-6		SS WORM CLAMP	¾" (1.9cm)	1
S-5		SS WORM CLAMP	½" (1.3cm)	1

2. Cut off the top of the silicone seal package and apply a liberal amount to the threads of the connector mounted on the antenna (see figure 5). Screw the PL-259 on the feedline to this connector. Tighten it finger tight.

3. Now apply the remaining silicone to the outside of the connector. Cover it liberally. Be sure to cover the back as this will insure a good weather seal. Slip boot over the connector. Push it as far forward as possible. (DO NOT APPLY SILICONE TO THE CONNECTOR CENTER PIN OR SOCKET)

INSTALLATION:

Following the guidelines in the LOCATION paragraph, place your antenna in its operating location. The base section will conveniently fit over a 1-7/8" (4.8 cm) O.D. tube.

Connect the control cable to terminal strip on the bottom of CTA. Spade lugs on the control cable ends will assist in making good and lasting connection.

Now connect your feedline to the R3. Installation of a Cushcraft Blitz Bug will aid in the dissipation of static electricity. Run your feedline and control cable to your operating position. Attach the feedline to your transmitter and the control cable to the control box. Be sure that the control cable is connected in the same sequence at both ends. Color coded cable will make this easier to achieve.

INITIAL ADJUSTMENT:

After assembly and installation of your R3, the lengths can be verified using the following procedure.

Turn ON the control box (CBA) and activate the TUNE switch to move the meter needle to the right end of the 10 meter strip. Set your transmitter to 28.000 MHz. Using a wattmeter or SWR bridge set to the reflected power position, adjust the antenna for minimum reflected power using the TUNE switch. If the SWR is above 1.5 to 1 at the lower band edges, lengthen section A (figure 4) by 1 in. (2.54 cm). It may be necessary to repeat this step several times until the SWR is below 1.5 to 1.

Now move the meter indicator to the other end of the 10 meter strip. Set your transmitter to 28.8 MHz. After minimizing the reflected power, using the TUNE switch, measure the SWR. If it exceeds 1.5 to 1 shorten section A. Repeat this step until the SWR is below 1.5 to 1.

Follow the same procedure for each end of 15 meters, adjusting section B. Use the same procedure to optimize each end of 20 meters, adjusting section C.

OPERATION:

To tune the R3 to your operating frequency, turn the control box ON, then activate the TUNE switch to move the indicator to the point on the meter near your operating frequency. As the meter indicator moves toward your frequency you may hear the signal levels in your receiver increase. Fine tuning can be accomplished by moving the TUNE control while monitoring the reflected power with a wattmeter or SWR meter. With a little practice you will be able to achieve very low SWR at any point on 10, 15 or 20 meters. Use the control box only as a guide. The SWR readings are the most important factors in capacitor positioning.

TROUBLE SHOOTING:

A trouble shooting guide has been provided to allow quick diagnosis of the most common problems.

Disconnect the control box from the control cable. Verify the voltages at the terminal strip on the rear of the control box. They should agree with Table I. A lighted meter face usually indicates the power transformer is working. In case the proper voltages are not encountered refer to the schematic diagram in Chart II.

If the problem has not yet been isolated, remove the control cable from the CTA. Check the resistances found on the CTA terminal strip with those found in Table II.

These voltage and resistance measurements will most likely uncover any electrical problem. Table II will help you to check mechanical functions.

TABLE I

Voltage measurements from the terminal strip of the R3 control box.

Apply primary power and turn the control box "ON". The following AC voltages should be obtained.

PIN 1 to PIN 2	O Vac
PIN 1 to PIN 3	
Tune switch to right	28 Vac
Tune switch to left	24 Vac
Tune switch at center	0 Vac
PIN 1 to PIN 4	
Tune switch to right	24 Vac
Tune switch to left	28 Vac
Tune switch to center	0 Vac

Variations of ± 20% are acceptable.
Readings were taken with 20K ohm per volt VOM.

TABLE II

Resistance measurements on capacitor tuning assembly terminal strip.

PIN 1 to PIN 2	between 100 and 1000 ohms (Pot. Winding)
PIN 1 to PIN 3	560 ohms (½ motor winding)
PIN 1 to PIN 4	560 ohms (½ motor winding
PIN 3 to PIN 4	1120 ohms (total motor winding)

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CHART I TROUBLE SHOOTING CHECK POINTS

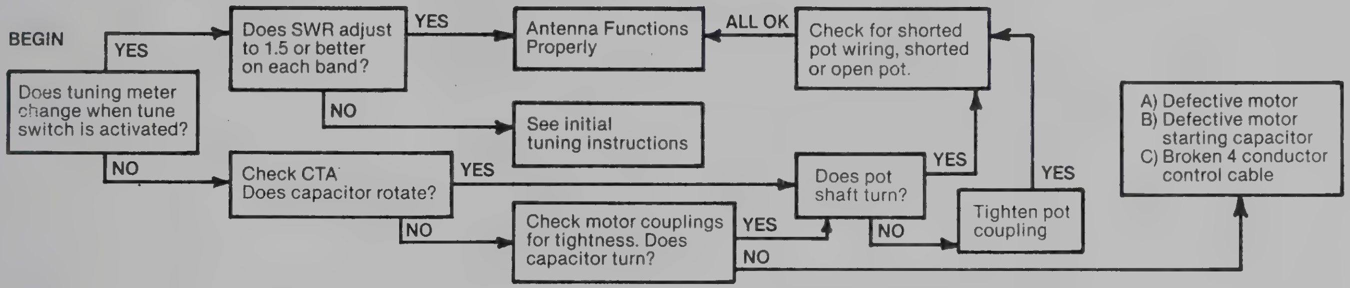
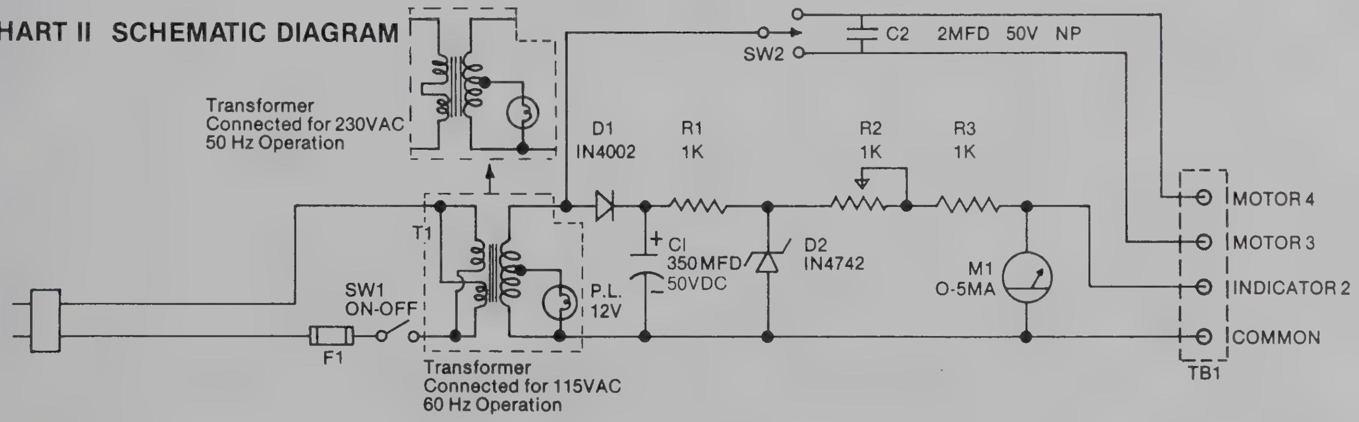

BEGIN
YES
Does tuning meter change when tune switch is activated?
NO
Does SWR adjust to 1.5 or better on each band?
YES
NO
Antenna Functions Properly
ALL OK
Check for shorted pot wiring, shorted or open pot.
See initial tuning instructions
Check CTA Does capacitor rotate?
YES
NO
Does pot shaft turn?
YES
NO
Check motor couplings for tightness. Does capacitor turn?
YES
NO
Tighten pot coupling
YES
A) Defective motor
B) Defective motor starting capacitor
C) Broken 4 conductor control cable

CHART II SCHEMATIC DIAGRAM



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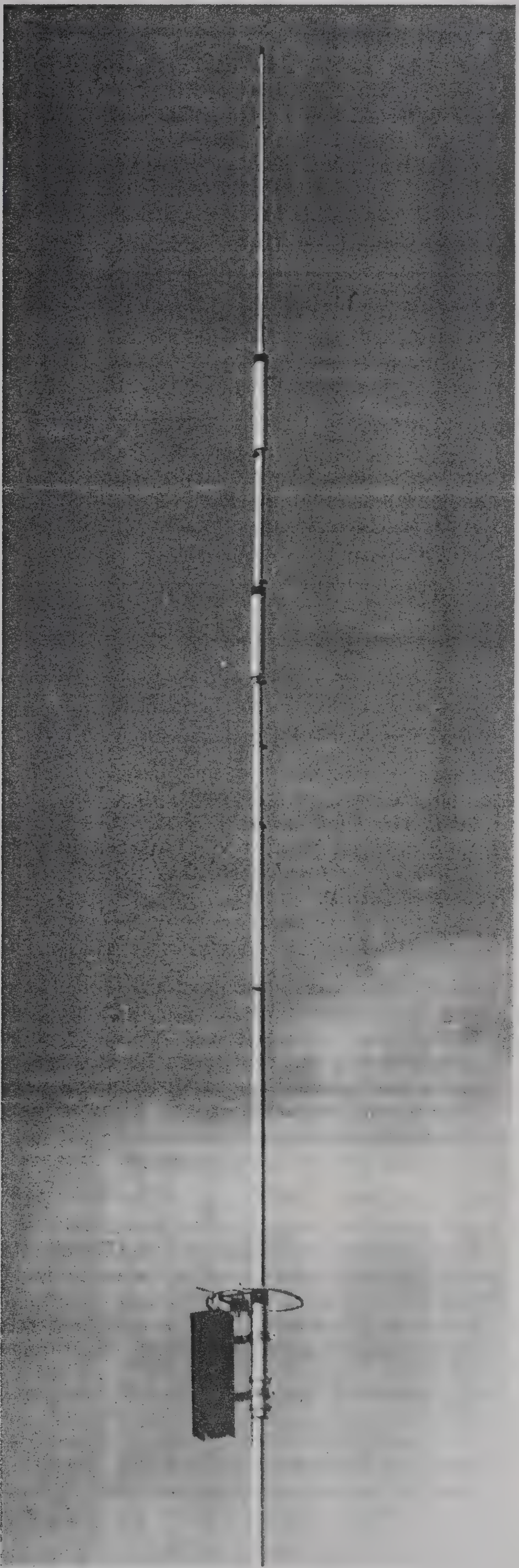

R3

10-15-20 METER ANTENNA

cushcraft
CORPORATION
THE ANTENNA COMPANY

AR3681

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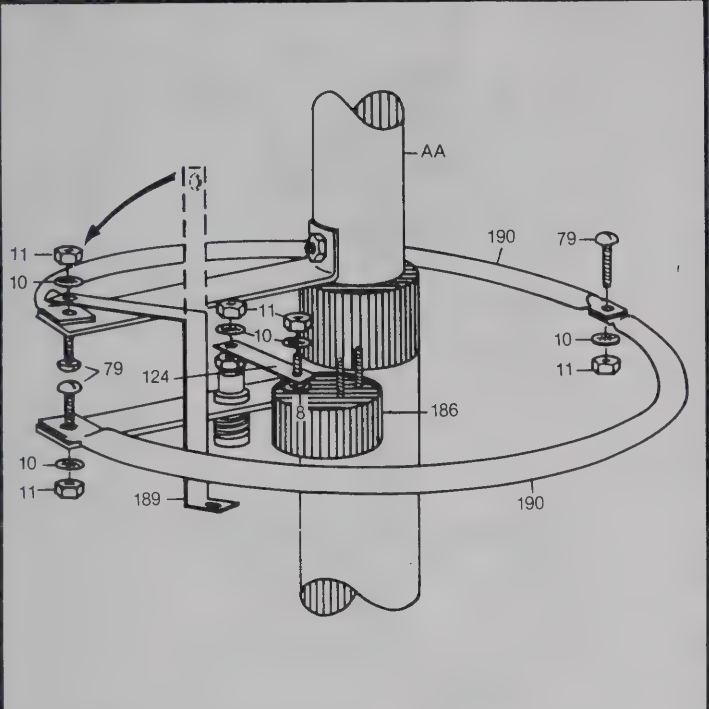
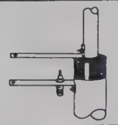
1 RING SECTION & MATCHING NETWORK ASSEMBLY



P/N	DETAIL	DESC.	SIZE	QTY.
AA		BASE SECTION	1⅜" OD (33.3cm) x 48" (121.9cm)	1
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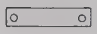
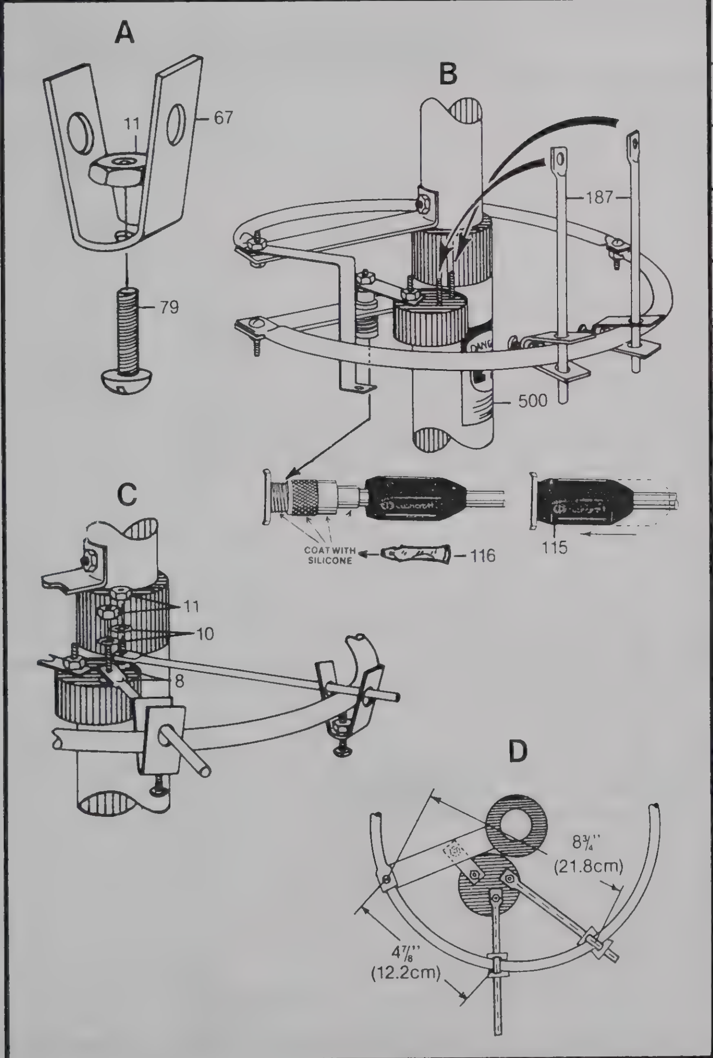
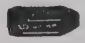
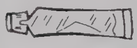
190		ALUMINUM RING SECTION	17" x ⅜" (43.2 x .95cm)	2
189		ALUMINUM CONNECTING STRAP	4⅞" x ⅜" (12.4 x .95cm)	1
124		ALUMINUM CONNECTOR STRAP	1½" x 7/16" (3.75 x 1.1cm)	1
79		SS R.H. MACHINE SCREW	#8-32 x ½" (1.27cm)	3
10		SS INTERNAL TOOTH LOCK WASHER	#8	5
11		SS HEX NUT	#8-32	5
8		ALUMINUM FLAT WASHER	#8	1

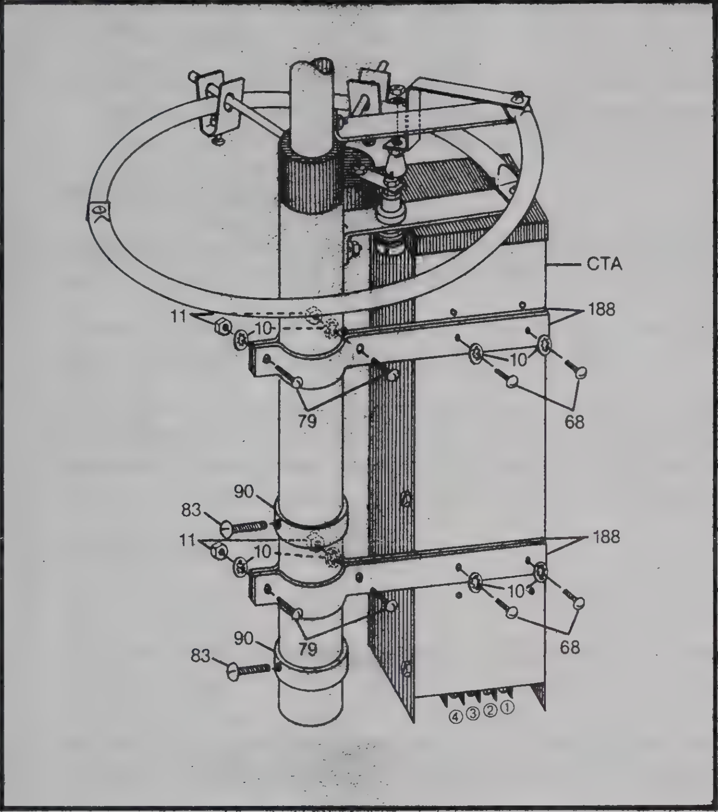
2 TUNING ROD ASSEMBLY

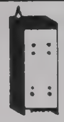


P/N	DETAIL	DESC.	SIZE	QTY.
187		ALUMINUM STRAIGHT TUNING ROD	5½" (13.97cm)	2
67		CR ALUMINUM TUNING ROD CLAMP		2
79		SS MACHINE SCREW	#8-32 x ½" (1.3cm)	2
10		SS INTERNAL TOOTH LOCK WASHER	#8	2
11		SS HEX NUT	#8-32	4
8		ALUMINUM FLAT WASHER	#8	2
115		VINYL CONNECTOR BOOT	2" (5.08cm)	1
116		SILICONE GREASE PACKET		1
500		DANGER LABEL		1

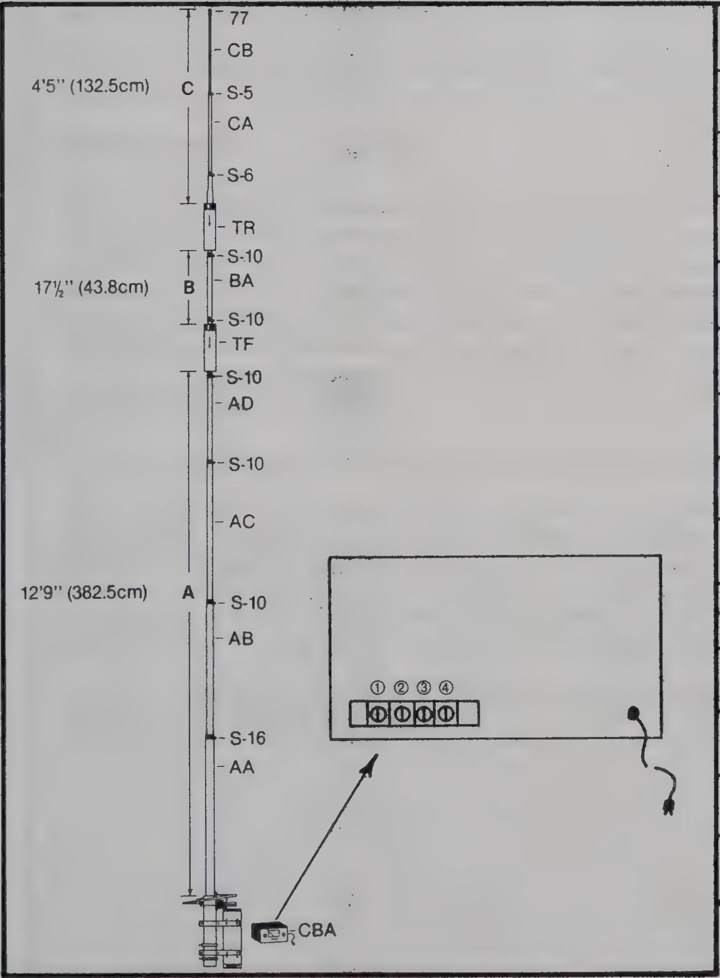
WARNING:
THIS ANTENNA IS AN ELECTRICAL CONDUCTOR, CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BULDINGS. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. FOLLOW THE GUIDELINES FOR ANTENNA INSTALLATIONS RECOMMENDED BY THE U.S. CONSUMER PRODUCT SAFETY COMMISSION AND LISTED IN THE ENCLOSED PAMPHLET.

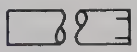
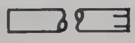
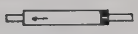
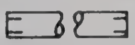
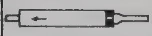
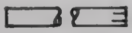
3 CAPACITOR TUNING ASSEMBLY



P/N	DETAIL	DESC.	SIZE	QTY.
CTA		CAPACITOR TUNING ASSEMBLY	3½" x 3½" x 12" (8.9 x 8.9 x 30.5cm)	1
188		FORMED ALUMINUM MOUNTING CLAMP	8" (20.3cm)	4
79		SS R.H. MACHINE SCREW	#8-32 x ½" (1.27cm)	4
10		SS INTERNAL TOOTH LOCK WASHER	#8	8
11		SS HEX NUT	#8-32	4
90		MAST MOUNT RING CLAMP		2
83		SS MACHINE SCREW	#¼-20 x 1¼" (3.18cm)	2
68		SS MACHINE SCREW	#8-32 x ⅜"(.95cm)	4

4 VERTICAL ASSEMBLY



P/N	DETAIL	DESC.	SIZE	QTY.
CBA		CONTROL BOX ASSEMBLY	4¼" x 6¼" x 3" (10.8 x 15.9 x 7.6cm)	1
S-16		SS WORM CLAMP	1 ¾"(4.4cm)	1
S-10		SS WORM CLAMP	1⅜" (3.5cm)	5
AB		ALUMINUM TUBING	1¼" x 48" (3.2 x 121.9cm) .058" Wall	1
AC		ALUMINUM TUBING	1⅛" x 48" (2.9 x 121.9cm) .058" Wall	1
AD		ALUMINUM TUBING	1" x 36" (2.5 x 91.4cm)	1
TF		10 METER TRAP	16⅝" (42.2cm)	1
BA		ALUMINUM TUBING	1" x 17" (2.5 x 43.2cm)	1
TR		15 METER TRAP	19" (48.3cm)	1
CA		ALUMINUM TUBING	½" x 36" (1.3 x 91.4cm)	1
CB		ALUMINUM TUBING	⅜" x 24" (.95 x 61.0cm)	1
77		BLACK PLASTIC CAP	⅜" (.95cm)	1
S-6		SS WORM CLAMP	¾" (1.9cm)	1
S-5		SS WORM CLAMP	½" (1.3cm)	1

2. Cut off the top of the silicone seal package and apply a liberal amount to the threads of the connector mounted on the antenna (see figure 5). Screw the PL-259 on the feedline to this connector. Tighten it finger tight.

3. Now apply the remaining silicone to the outside of the connector. Cover it liberally. Be sure to cover the back as this will insure a good weather seal. Slip boot over the connector. Push it as far forward as possible. (DO NOT APPLY SILICONE TO THE CONNECTOR CENTER PIN OR SOCKET)

INSTALLATION:

Following the guidelines in the LOCATION paragraph, place your antenna in its operating location. The base section will conveniently fit over a 1-7/8" (4.8 cm) O.D. tube.

Connect the control cable to terminal strip on the bottom of CTA. Spade lugs on the control cable ends will assist in making good and lasting connection.

Now connect your feedline to the R3. Installation of a Cushcraft Blitz Bug will aid in the dissipation of static electricity. Run your feedline and control cable to your operating position. Attach the feedline to your transmitter and the control cable to the control box. Be sure that the control cable is connected in the same sequence at both ends. Color coded cable will make this easier to achieve.

INITIAL ADJUSTMENT:

After assembly and installation of your R3, the lengths can be verified using the following procedure.

Turn ON the control box (CBA) and activate the TUNE switch to move the meter needle to the right end of the 10 meter strip. Set your transmitter to 28.000 MHz. Using a wattmeter or SWR bridge set to the reflected power position, adjust the antenna for minimum reflected power using the TUNE switch. If the SWR is above 1.5 to 1 at the lower band edges, lengthen section A (figure 4) by 1 in. (2.54 cm). It may be necessary to repeat this step several times until the SWR is below 1.5 to 1.

Now move the meter indicator to the other end of the 10 meter strip. Set your transmitter to 28.8 MHz. After minimizing the reflected power, using the TUNE switch, measure the SWR. If it exceeds 1.5 to 1 shorten section A. Repeat this step until the SWR is below 1.5 to 1.

Follow the same procedure for each end of 15 meters, adjusting section B. Use the same procedure to optimize each end of 20 meters, adjusting section C.

OPERATION:

To tune the R3 to your operating frequency, turn the control box ON, then activate the TUNE switch to move the indicator to the point on the meter near your operating frequency. As the meter indicator moves toward your frequency you may hear the signal levels in your receiver increase. Fine tuning can be accomplished by moving the TUNE control while monitoring the reflected power with a wattmeter or SWR meter. With a little practice you will be able to achieve very low SWR at any point on 10, 15 or 20 meters. Use the control box only as a guide. The SWR readings are the most important factors in capacitor positioning.

TROUBLE SHOOTING:

A trouble shooting guide has been provided to allow quick diagnosis of the most common problems.

Disconnect the control box from the control cable. Verify the voltages at the terminal strip on the rear of the control box. They should agree with Table I. A lighted meter face usually indicates the power transformer is working. In case the proper voltages are not encountered refer to the schematic diagram in Chart II.

If the problem has not yet been isolated, remove the control cable from the CTA. Check the resistances found on the CTA terminal strip with those found in Table II.

These voltage and resistance measurements will most likely uncover any electrical problem. Table II will help you to check mechanical functions.

TABLE I

Voltage measurements from the terminal strip of the R3 control box.

Apply primary power and turn the control box "ON". The following AC voltages should be obtained.

PIN 1 to PIN 2	0 Vac
PIN 1 to PIN 3	
Tune switch to right	28 Vac
Tune switch to left	24 Vac
Tune switch at center	0 Vac
PIN 1 to PIN 4	
Tune switch to right	24 Vac
Tune switch to left	28 Vac
Tune switch to center	0 Vac

Variations of ± 20% are acceptable.
Readings were taken with 20K ohm per volt VOM.

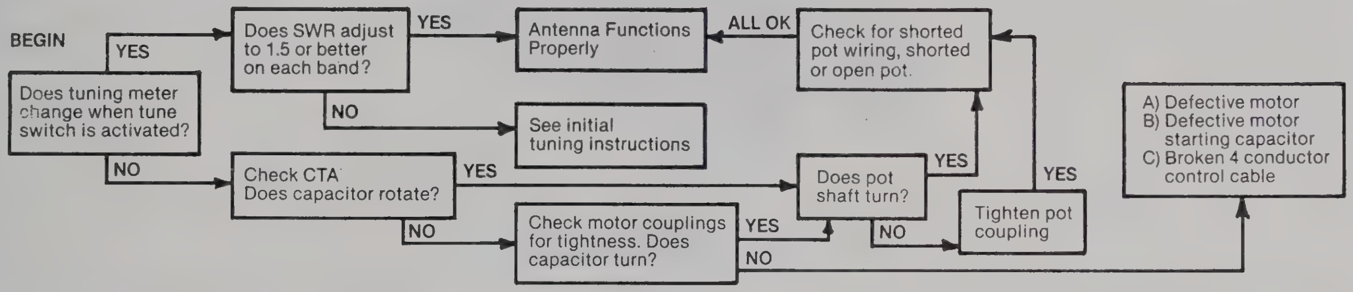
TABLE II

Resistance measurements on capacitor tuning assembly terminal strip.

PIN 1 to PIN 2	between 100 and 1000 ohms (Pot. Winding)
PIN 1 to PIN 3	560 ohms (½ motor winding)
PIN 1 to PIN 4	560 ohms (½ motor winding
PIN 3 to PIN 4	1120 ohms (total motor winding)

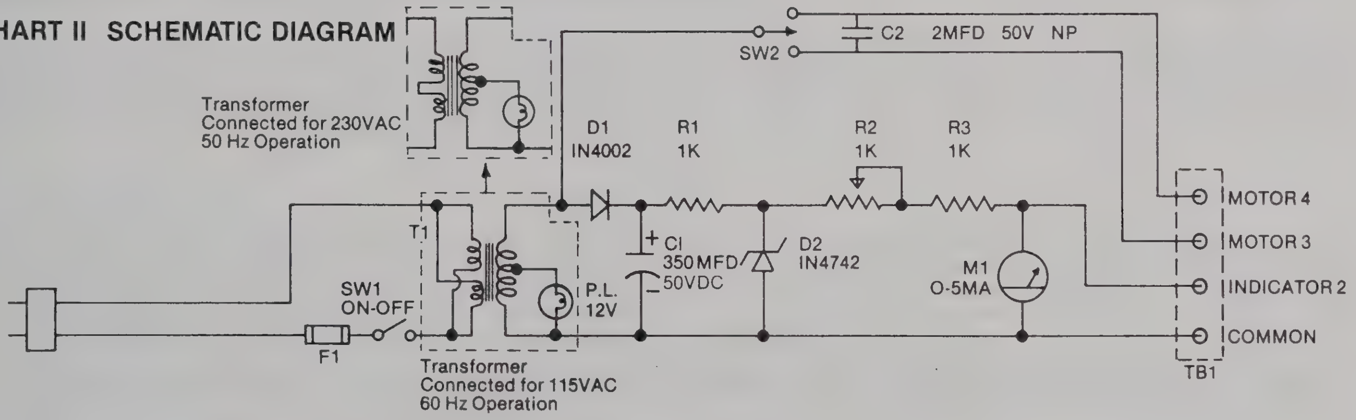
Variations of ±20% are acceptable.
Readings were taken with 20K ohm per volt VOM.

CHART I TROUBLE SHOOTING CHECK POINTS



BEGIN
Does tuning meter change when tune switch is activated?
YES
Does SWR adjust to 1.5 or better on each band?
YES
Antenna Functions Properly
ALL OK
Check for shorted pot wiring, shorted or open pot.
NO
See initial tuning instructions
NO
Check CTA Does capacitor rotate?
YES
Does pot shaft turn?
YES
YES
A) Defective motor
B) Defective motor starting capacitor
C) Broken 4 conductor control cable
NO
Check motor couplings for tightness. Does capacitor turn?
YES
NO
Tighten pot coupling
NO

CHART II SCHEMATIC DIAGRAM



LIMITED WARRANTY:

CUSHCRAFT CORPORATION, P.O. BOX 4680, MANCHESTER, NEW HAMPSHIRE 03108, WARRANTS TO THE ORIGINAL CONSUMER PURCHASER FOR ONE YEAR FROM DATE OF PURCHASE THAT EACH CUSHCRAFT ANTENNA IS FREE OF DEFECTS IN MATERIAL OR WORKMANSHIP. IF, IN THE JUDGEMENT OF CUSHCRAFT, ANY SUCH ANTENNA IS DEFECTIVE, THEN CUSHCRAFT CORPORATION WILL, AT ITS OPTION, REPAIR OR REPLACE THE ANTENNA AT ITS EXPENSE WITHIN THIRTY DAYS OF THE DATE THE ANTENNA IS RETURNED (AT PURCHASER'S EXPENSE) TO CUSHCRAFT OR ONE OF ITS AUTHORIZED REPRESENTATIVES. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESSED WARRANTIES. ANY IMPLIED WARRANTY IS LIMITED IN DURATION TO ONE YEAR. CUSHCRAFT CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM A DEFECT. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR EXCLUSIONS OR LIMITATIONS OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION AND EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. THIS WARRANTY DOES NOT EXTEND TO ANY PRODUCTS WHICH HAVE BEEN SUBJECT TO MISUSE, NEGLECT, ACCIDENT OR IMPROPER INSTALLATION. ANY REPAIRS OR ALTERATIONS OUTSIDE OF THE CUSHCRAFT FACTORY WILL NULLIFY THIS WARRANTY.

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SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

TECHNICAL DATA AND SPECIFICATIONS

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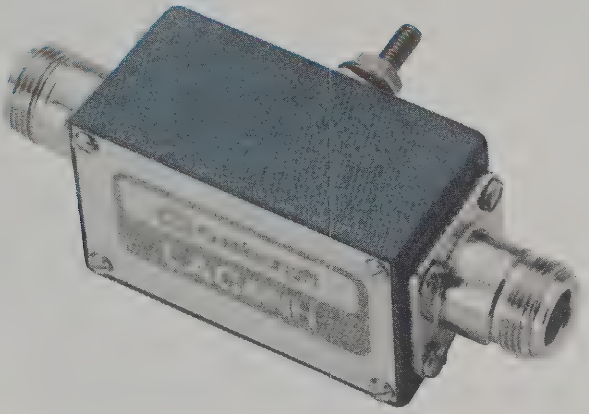
LAC-4 SERIES
LIGHTNING ARRESTERS



Cushcraft LAC-4 Lightning Arresters

The Cushcraft LAC-4 series of lightning arresters are designed to protect radio equipment from static electricity and lightning induced surges that travel on coaxial transmission lines. The LAC-4 protects your equipment from surges up to 5,000 Amperes.

The Cushcraft LAC-4 is superior to other available devices because it presents a constant impedance to your transmission line. Mechanically the LAC-4 has been designed to last. All of the mechanical connections in the LAC-4 are positively secured. The gas discharge tube is easily changed by the user if necessary. Our lightning arresters feature a straight forward design. Check our documentation. We are more thorough in telling you what to expect of your LAC-4. The LAC-4 is packaged in an attractively styled diecast box. We have paid particular attention to the details of the fit and finish. The LAC-4 is another example of Cushcraft's committment to supplying quality performance products for radio applications.

THEORY OF OPERATION:

The LAC-4 is a gas discharge tube positioned on a short piece of 50 Ohm transmission line. This gas discharge tube nearly instantaneously changes from an open circuit to a short circuit in the presence of voltage and energy surges, thus providing a path for the surge to follow to ground. The LAC-4 is designed to provide a short circuit path to ground for any fast rise time pulse. It will normally protect sensitive communications equipment from damage. Failure of semiconductor devices is either energy or voltage related, depending upon the semiconductor family. P-N junction type devices (silicon transistors for example) have energy related failure modes. Other devices such as insulated gate FETs or MOS devices will suffer primarily voltage related failures.

The LAC-4 easily prevents energy related failures by the shunting effect of the device. Surge voltages are clamped (ie, limited) to less than 50 volts in about 100 nanoseconds. A typical lightning surge has a voltage rise time of around 2 microseconds. The accepted IEEE standard for testing transient suppressors is an 8 microsecond rise time. Clearly little voltage will be allowed through by the LAC-4.

Some voltage related semiconductor failures can occur even with a properly operating LAC-4. Insulated gate FETs are a prime example. Normally equipment using IGFETS include circuitry to protect these devices. Diodes and filters can provide a measure of protection for such fragile semiconductors. In any event, the LAC-4 will provide the main energy shunt to ground due to its very high current carrying capacity. Many costly repairs can be avoided by installing an LAC-4 in your feedline. With today's sensitive radio equipment, this type of protection has become a requirement.

AVAILABLE MODELS:

The LAC-4 series includes four models —

Model	Connector Type	Maximum Power	Impedance
LAC-4	UHF Female	200 Watts	50 Ohms
LAC-4H	UHF Female	2000 Watts	50 Ohms

Model	Connector Type	Maximum Power	Impedance
LAC-4N	N-Female	200 Watts	50 Ohms
LAC-4NH	N-Female	2000 Watts	50 Ohms

TYPICAL APPLICATIONS

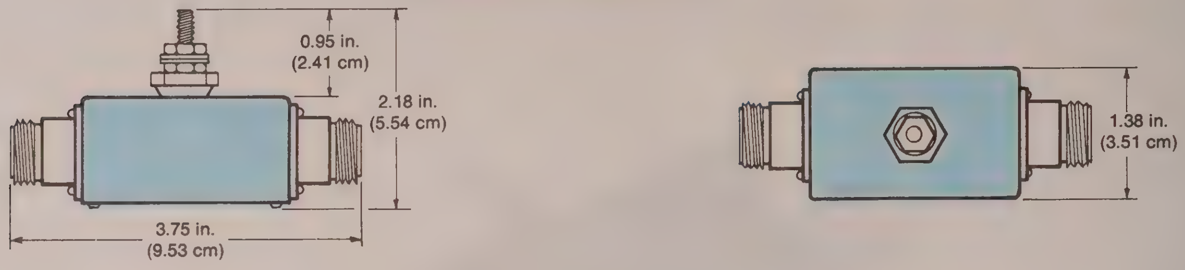
- Repeaters
- Remote Telemetry Transmitters
- Long Range Wireless Alarms
- Tower Mounted RF Equipment
- Amateur Radio Stations
- SWL Receivers

And Other Communications Equipment

INSTALLATION:

It is best to mount the LAC-4 as close to earth ground as possible. It should be mounted either indoors or inside a protected area. The most common installation is just inside the wall where the coaxial cable enters the building. This location is the best since the ground connection lead can be made the shortest length. It is good practice to attach the discharge terminal directly to ground. Sharp bends or loops in the ground wire should be avoided. Appropriate conductors such as #10 solid copper, bronze, or copper clad steel should be selected as the ground wire. (See National Electrical Codes). The dimensions of the LAC-4N are illustrated.

LAC-4 DIMENSIONS



LIFE EXPECTANCY AND FAILURE MODE:

The life of the gas discharge tube depends upon how often it is required to protect your equipment. Very large and frequent surges will reduce its life. Infrequent or small surges will have very little effect on the gas discharge tube. The LAC-4 may deteriorate as the gas tube is exercised. Deterioration may be detected while transmitting as either high VSWR or a warm discharge tube. Deterioration is not apparent when receiving until the unit has failed. When the tube completely fails, it fails shorted, thus giving you the greatest protection. Replacement of the gas discharge tube is a simple matter of replacing the cartridge which is available as a separate item.

SENSITIVITY TO FREQUENCY:

The LAC-4 design and the gas discharge tube are generally not sensitive to frequency. However, the connectors used to attach the LAC-4 to your transmission line are frequency sensitive. Table 1 shows the performance of the LAC-4 at VHF/UHF frequencies.

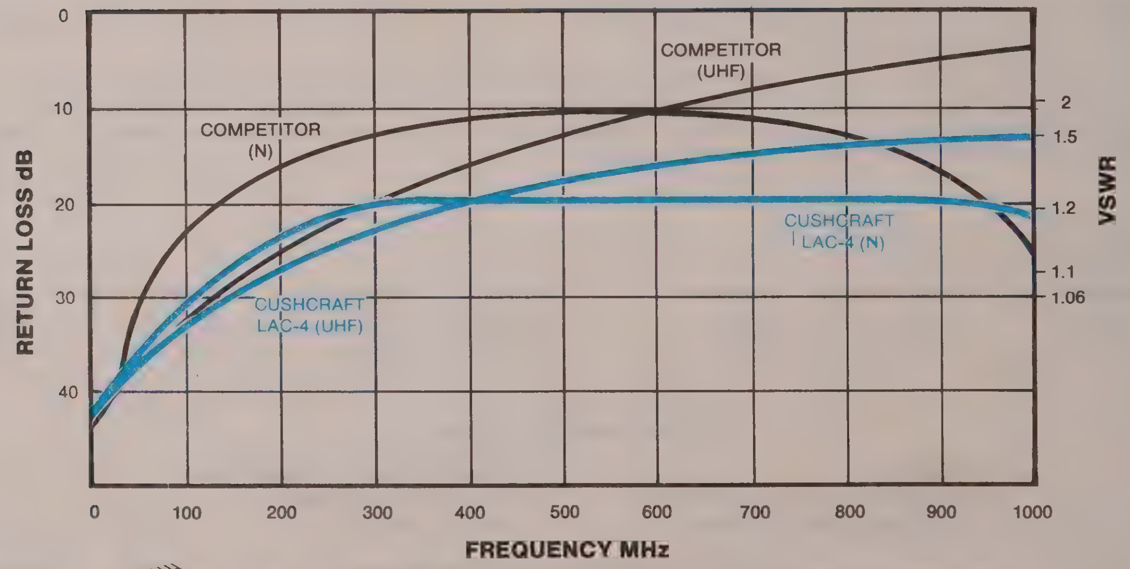
Table 1

Model	Frequency	Max. Power	Insertion Loss
LAC-4	30 MHz	200 W	Less than 0.1 dB
	150	200	Less than 0.1 dB
	500	100	0.25 dB typical
LAC-4H	30	2000	Less than 0.1 dB
	150	500	Less than 0.1 dB
	500	100	0.25 db typical

Model	Frequency	Max. Power	Insertion Loss
LAC-4N	30	200	Less than 0.1 dB
	150	200	Less than 0.1 dB
	500	200	Less than 0.1 dB
	1000	150	0.25 dB typical
LAC-4NH	30	2000	Less than 0.1 dB
	150	1000*	Less than 0.1 dB
	500	800*	Less than 0.1 dB
	1000	500*	0.15 dB typical

*Limited by Type-N connector design

RETURN LOSS/VSWR
COMPARISON
LAC-4 VS. COMPETITORS MODELS



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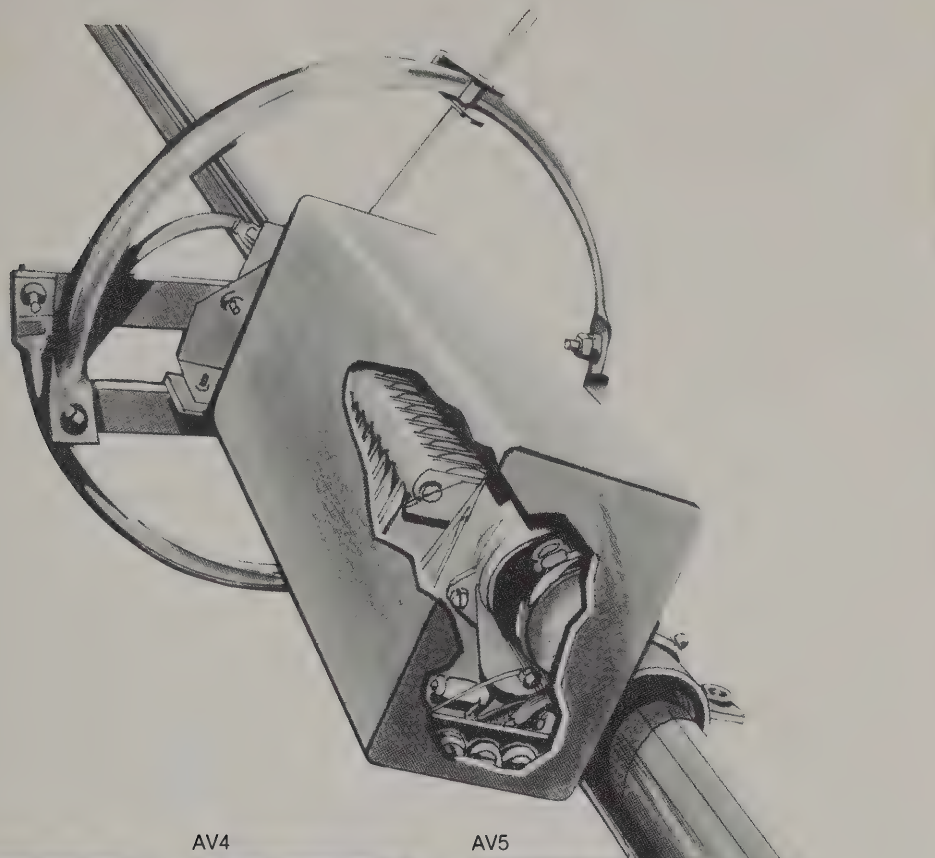
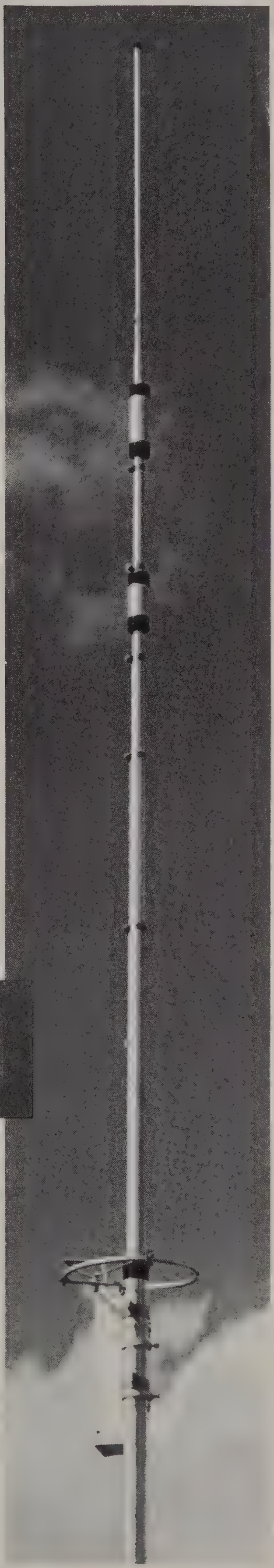
MULTIBAND VERTICALS CUSHCRAFT

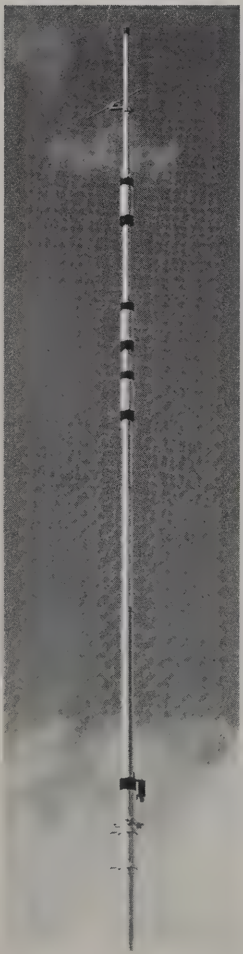


R3

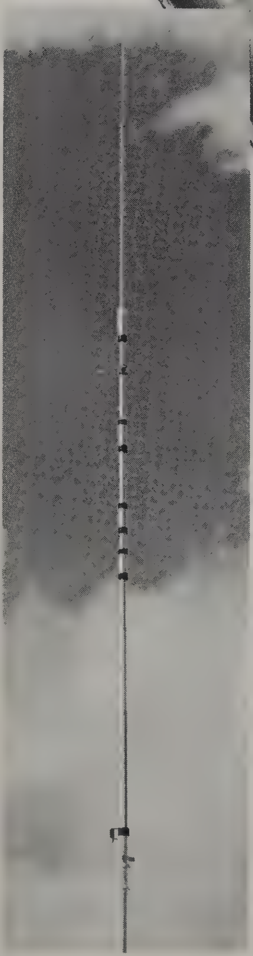


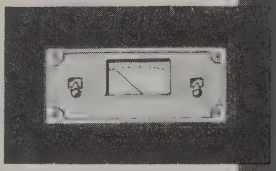
AV3

AV4



AV5





TECHNICAL DATA

With this catalog we are introducing many new and improved antennas. These new products result from more than 30 years of research and refinement. Whatever your ham radio interest may be from rag chewing to contesting EME or DXing there is a Cushcraft antenna for you. All of the hams at Cushcraft are dedicated to giving you the best possible performance and value for your antenna investment. We look forward to meeting you on the bands.

A4 4 ELEMENT 20 15 10 METERS

A true champion, our new A4 is based on the very successful ATB-34. It outperforms many larger beams because of our high Q traps and excellent spacing to element length ratios. A4 gives maximum performance with good dimensions and turn radius. Improve the number and quality of your contacts with a contest winning A4.

Forward Gain	8.9 dBd
Front to Back Ratio (Avg)	25 dB
VSWR	1.2 - 1 Typical
Bandwidth (Avg)	500 KHz
Power Rating	2000 W PEP
Feed Point Impedance	50 ohms
Connector	Twin terminal stainless steel takes all coax.
Hardware	Zinc plated steel
Boom (ft-in) (cm)	18' x 2" 548.6 x 5.1
Longest Element (ft-in) (cm)	32' x 1.13" - .50" 975.4 x 2.9 to 1.3
Wind Surface Area (ft²) (m²)	5.5 0.51
Weight (lb) (kg)	37 16.8
Turning Radius (ft) (cm)	18.4 561
Mast Diameter (in) (cm)	1.25 to 2.13 3.2 to 5.4
Material	6063-T832 Seamless Aluminum
Telescope Method	Taper tubing with full circle clamps
UPS Shippable No Balun Required	

A3 3 ELEMENT 20 15 10 METERS

Make friends of your neighbors with A3 compact dimensions low profile and small turn radius. Satisfy your budget with A3 economy pricing. You will also realize savings by using a lighter weight tower and rotator. This is one compact beam that has the strength and power of most larger antennas.

Forward Gain	8 dBd
Front to Back Ratio (Avg)	25dB
VSWR	1.2 - 1 Typical
Bandwidth (Avg)	500 KHz
Power Rating	2000 W PEP
Feed Point Impedance	50 ohms
Connector	Twin terminal stainless steel takes all coax.
Boom (ft-in) (cm)	14' x 1.63" - 1.50" 426.7 x 4.13 - 3.81
Longest Element (ft-in) (cm)	27.75' x 1.13" - .50" 845.8 x 2.86 - 1.27
Wind Surface Area (ft²) (m²)	4.36 .47
Weight (lb) (kg)	27 2.19
Turning Radius (ft) (m)	15.50 4.72
Mast Diameter (in) (cm)	1.25 min. 2 max. 3.18 to 5.08
Material	6063-T832 Seamless Aluminum
Hardware	Zinc Plated Steel
Telescope Method	Taper tubing with full circle clamps
UPS Shippable No balun required	

4 BAND ADAPTER KITS

Add more capability to your A3 or A4 beam with these easy to use add on kits. All components are included to give you 7 MHz or the new 10 MHz WARC band coverage. The adapters simply clamp to the existing element tubing to give four band performance.

7 MHz ADAPTER KIT A74	
Length (7 MHz Section) (in) (m)	63.75 1.61
Wind Loading (ft²) (m²)	.58 .05
Weight (lb) (kg)	3.44 1.56
Bandwidth	150 KHz
Side Rejection	40 dB
Driven Element Length (ft) Without Adapter Kit (m)	25.08 7.59
Driven Element Length (ft) With Adapter Kit (m)	34.66 10.55

10 MHz ADAPTER KIT A104	
Length (10 MHz Section) (in) (m)	36 .91
Wind Loading (ft²) (m²)	.27 .03
Weight (lbs) (kg)	2.29 1.04
Bandwidth	150 KHz
Side Rejection	40 dB
Driven Element Length (ft) Without Adapter Kit (m)	25.08 7.59
Driven Element Length (ft) With Adapter Kit (m)	31.08 9.42

Specifications subject to change without notice.

STAINLESS STEEL HARDWARE KITS

Convert your beam to all stainless steel hardware, includes necessary clamps, U-bolts, and fasteners.

A3 YAGI KIT = A3SK

A4 YAGI KIT = A4SK

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AMATEUR PRICE SCHEDULE

MULTI BAND HF ANTENNAS

A3	14, 21, 28 MHz 3 element beam	$219.95
A3SK	Stainless Steel Hardware for A3	39.95
A4	14, 21, 28 MHz 4 element beam	289.95**
A4SK	Stainless Steel Hardware for A4	42.95**
A74	7 MHz add on kit	69.95**
A104	10 MHz add on kit	69.95**
AV3	14, 21, 28 MHz vertical	54.95*
AV4	7, 14, 21, 28 MHz vertical	112.95*
AV5	3.8, 7, 14, 21, 28 MHz vertical	119.95*
R3	14, 21, 28 MHz Ringo	299.95***

SKYWALKER HF YAGIS

20-4CD	14 MHz, 4 element	$319.95
20-3CD	14 MHz, 3 element	219.95
15-4CD	21 MHz, 4 element	129.95
15-3CD	21 MHz, 3 element	109.95
10-4CD	28 MHz, 4 element	99.95
10-3CD	28 MHz, 3 element	79.95

BOOMER ANTENNAS

32-19	144-146 MHz, 19 element 3.2λ	$ 99.95
214B	144-146 MHz, 14 element 2.2λ	79.95
214FB	145.5-148 MHz, 14 element 2.2λ	79.95
220B	220-223 MHz, 17 element 4.2λ	89.95
228FB	145.5-148 MHz, 28 element 2.2λ	249.95
617-6B	50-51 MHz, 6 element 1.7λ	229.95

BOOMER STACKING KITS

22-SK	Stacking Harness & P.D., 2 Jr. Boomers	$ 39.95
32-SK	Stacking Harness & P.D., 2 Boomers	44.95
220-SK	Stacking Harness & P.D., 2, 220B	44.95
224-QK	Quad Stacking Kit, 4 Jr. Boomers	279.95
324-QK	Quad Stacking Kit, 4 Boomers	439.95
617-SK	Stacking Harness & P.D., 2 617-6B	59.95
PD-4	Power Divider, four 2 meter Boomers	32.95
PD-24	Power Divider, four 220 Boomers	32.95

VHF/UHF YAGIS

A50-3	50 MHz, 3 element beam	$ 54.95
A50-5	50 MHz, 5 element beam	74.95
A50-6	50 MHz, 6 element beam	99.95
A144-7	144 MHz, 7 element beam	32.95
A144-11	144 MHz, 11 element beam	44.95
A220-11	220-225 MHz, 11 element beam	42.95
A147-20T	144-148 MHz Twist, 20 element	74.95
A430-11	432 MHz, 11 element beam	42.95

VHF/UHF STACKING KITS

A11-SK	Stacking kit for two A144-11	$ 22.95
A17-SK	Stacking kit for two A144-7	22.95
A21-SK	Stacking kit for two A220-11	22.95
A41-SK	Stacking kit for two A430-11	22.95
A535-SK	Stacking kit for two A50-3 or 5	22.95
A561-SK	Stacking kit for two A50-6	24.95

FM ANTENNAS

A147-4	146-148 MHz, 4 element	$ 29.95
A147-11	146-148 MHz, 11 element	44.95
A147-22	146-148 MHz, 22 element	129.95
A220-7	220-225 MHz, 7 element	32.95
A449-6	449 MHz, 6 element	29.95
A449-11	449 MHz, 11 element	42.95
AFM-4D	144-148 MHz Four Pole	79.95
AFM-24D	220-225 MHz Four Pole	72.95
AFM-44D	440-450 MHz Four Pole	67.95
AR-2	135-170 MHz Ringo	27.95
AR-6	50-54 MHz Ringo	44.95
AR-10	28-29.7 MHz Ringo	44.95
AR220	220-225 MHz Ringo	24.95
AR-450	440-460 MHz Ringo	24.95
ARB-2K	144-174 MHz Ranger II Kit	19.95
ARB-220K	220-225 MHz Ranger II Kit	19.95
ARB-450K	435-470 MHz Ranger II Kit	19.95
ARX-2B	144-174 MHz Ringo Ranger II	49.95
ARX-220B	220-225 MHz Ringo Ranger II	49.95
ARX-450B	435-470 MHz Ringo Ranger II	49.95

FM STACKING KITS

A14-SK	Stacking kit for two A147-4	$ 22.95
A14-VPK	Vert. Pol. kit for two A147-4	32.95
A147-SK	Stacking kit for two A147-11	22.95
A147-VPK	Vert. Pol. kit for two A147-11	49.95
A449-SK	Stacking kit for 2, A449-6 or 11	22.95
A449-VPK	Vert. Pol. kit for 2, A449-6 or 11	32.95

MOBILE ANTENNAS

AMS-147	146-148 MHz Stainless magnet mount	$ 32.95
ATS-147	146-148 MHz Stainless trunk mount	32.95
AMS-220	220-225 MHz Stainless magnet mount	32.95
ATS-220	220-225 MHz Stainless trunk mount	32.95

DX ARRAYS - 20 ELEMENT

DX-120	144 MHz, 20 element colinear	$ 67.95
DX-220	220 MHz, 20 element colinear	54.95
DX-420	432 MHz, 20 element colinear	44.95

DX ARRAY BALUNS

DX-1BN	1-1 balun for DX-120	$ 18.95
DX-2BN	1-1 balun for DX-220	18.95
DX-4BN	1-1 balun for DX-420	18.95

TWIST ANTENNAS

A14T-MB	Twist mounting boom & bracket	$ 24.95
A144-10T	145 MHz, 10 element	54.95
A144-20T	145 MHz, 20 element	74.95
A432-20T	433.6 MHz, 20 element	59.95

ACCESSORIES

AFB-2	Broadband balun	$ 39.95
LAC-1	Coax Lightning arrester	5.95
LAC-2	Coax Lightning arrester	5.95
5VB	5 Vinyl Connector Boots	4.95

* Available Dec. 10, 1980
** Available Dec. 5, 1980
*** Available Dec. 19, 1980

ANP-12

48 Perimeter Road, P.O. Box 4680 Manchester, NH 03108

cushcraft

THE
ANTENNA
COMPANY

HF-VHF-UHF AMATEUR ANTENNAS

NEW PRODUCTS IN THIS CATALOG

- 215WB SSB/FM BOOMER
- CUSHCRAFT/SIGNALS MOBILE AND PORTABLE ANTENNAS
- THRU THE WALL LIGHTNING ARRESTER
- 4218XL BOOMER
- 230WB FM ARRAY
- NEW IMPROVED RUGGEDIZED FOUR POLES

BARRY ELECTRONICS CORP.
512 BROADWAY
NEW YORK, N. Y. 10012

CATALOG A15

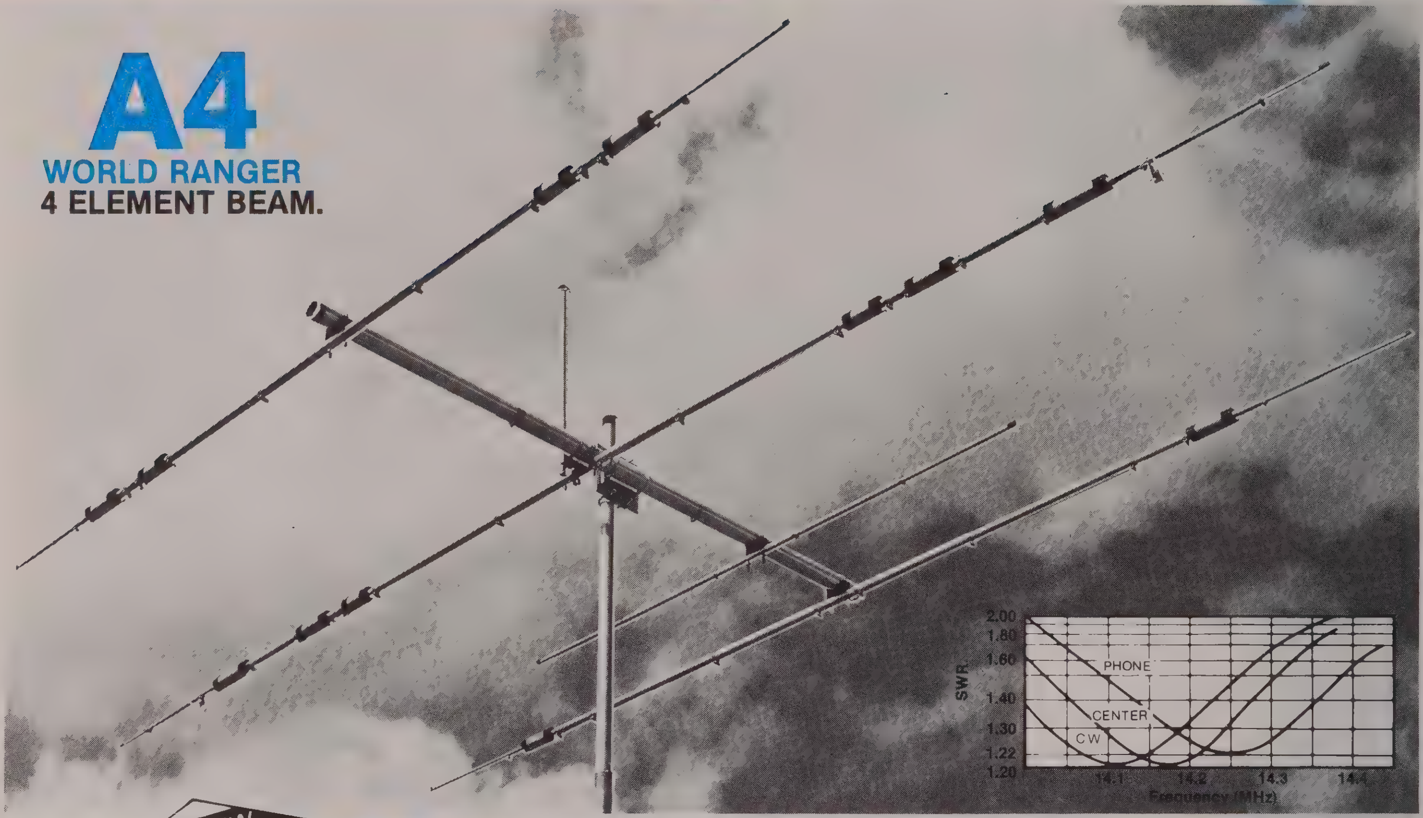
WIDEBAND

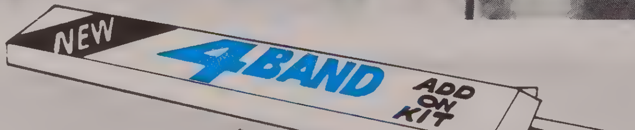
cushcraft

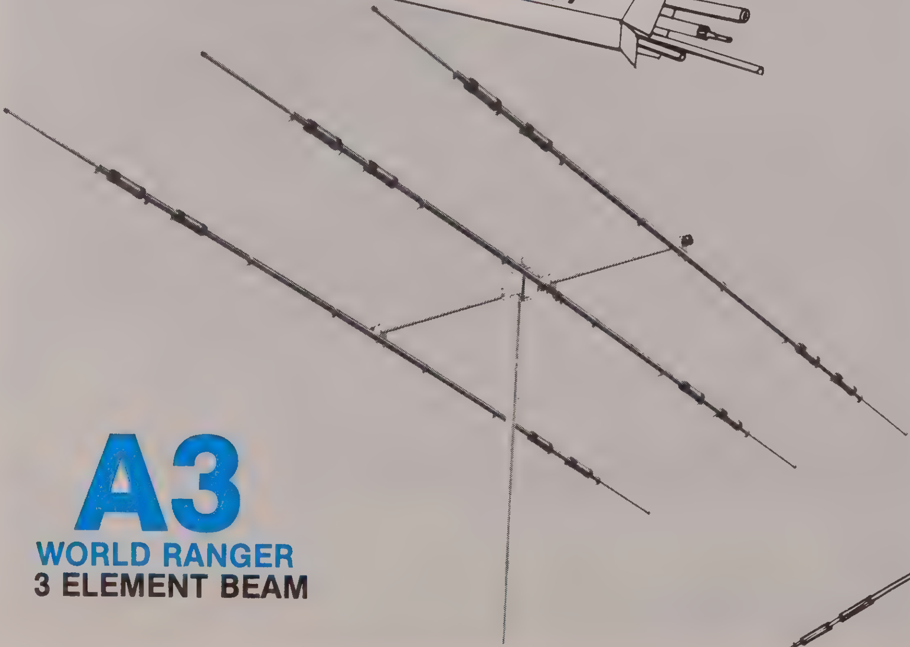
WORLD RANGER BEAMS 10, 15, 20, 40 METERS

A4

WORLD RANGER
4 ELEMENT BEAM.







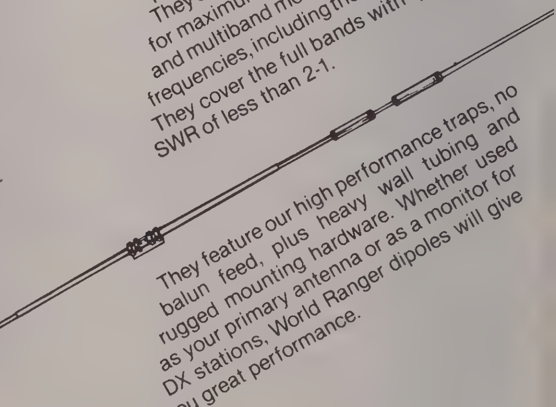
A3

WORLD RANGER
3 ELEMENT BEAM

NEW!

WORLD RANGER ROTATABLE DIPOLES

Cushcraft World Ranger dipoles give you the performance advantages of bi-directional patterns with the ability to be easily rotated. They can be mounted up high and in the clear for maximum performance. There are single and multiband models to cover your favorite frequencies, including the new WARC bands. They cover the full bands with typical SWR of less than 2-1.



They feature our high performance traps, no balun feed, plus heavy wall tubing and rugged mounting hardware. Whether used as your primary antenna or as a monitor for DX stations, World Ranger dipoles will give you great performance.

IT'S EASY TO ADD 40 METERS TO YOUR CUSHCRAFT TRIBANDER

cushcraft

MAKE WORLDWIDE DX MORE FUN

A4 WORLD RANGER 4 ELEMENT BEAM 10, 15, 20 METERS

A true champion, our A4 continues to outperform other beams in day-to-day operation and the tough competition of contests. It has achieved the success of DXCC in only two days. A4 performance results from combining precisely tuned high power traps with excellent spacing to element length ratios.

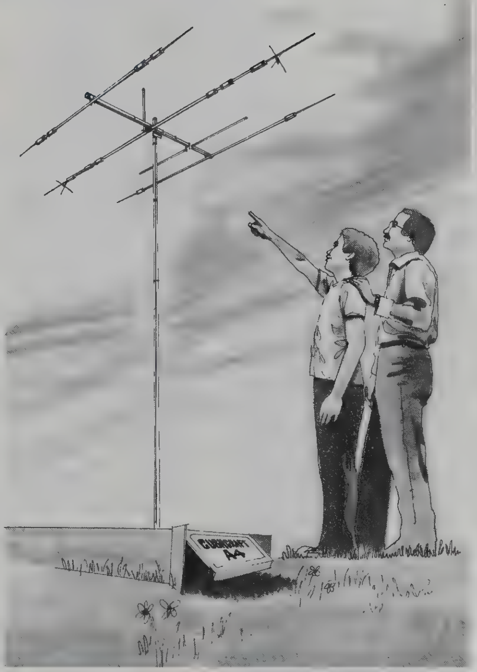
The antenna is designed with fewer parts for easier assembly—less weight and a clean profile to reduce windload. Important construction details include G-10 fiberglass insulators, epoxy coated—weatherproof coils, galvanized steel element clamps, stainless steel boom and dipole clamps, plus anti-twist elements for greater strength and durability.

You too can improve the number and quality of your contests with a contest winning World Ranger A4 beam.

Forward Gain	8.9 dBd
Front to Back Ratio, Avg	25 dB
SWR	1.2-1 Typical
Bandwidth, Avg KHz	500
Power Rating, Watts	2000 PEP
Feed Point Impedance	50 Ohms
Connector	Twin terminal stainless
No Balun Required	steel takes all coax.
Hardware	Zinc Plated Steel
Boom, ft (cm)	18 × 2 (548.6 × 5.1)
Longest Element & diameter, ft	32 × 1.13 – .50
(cm)	(975.4 × 2.9 to 1.3)
Wind Surface Area, ft²(m²)	5.5 (0.51)
Turning Radius, ft (cm)	18.4 (561)
Mast Diameter, in	1.25 min. 2 max.
(cm)	(3.18 to 5.08)
Material	6063-T832 Seamless Aluminum
Telescope Method	Taper tubing with full circle clamps
Weight, lb(kg)	37 (16.8)

WORLD RANGER DIPOLE SPECIFICATIONS

MODEL	D40	D3	D4	DW3
Frequency, m	40	10,15,20	10,15,20,40	12,16,30
Bandwidth, KHz at 2:1 SWR	200	>500	>350 40 >125	> 250
SWR at Resonance	1.5:1	1.5:1	1.5:1	1.5:1
Power Rating, Watts PEP	2000	2000	2000	2000
Length, ft	42.25	25.8	35.8	34.0
(m)	(12.88)	(7.86)	(10.92)	(10.37)
Mast Diameter max., in	2	2	2	2
(cm)	(5)	(5)	(5)	(5)
Windload, ft²	1.3	.9	1.3	.9
(m²)	(.12)	(.08)	(.12)	(.08)
Weight, lb	12	9	13	11
(kg)	(5)	(4)	(6)	(5)



WORLD RANGER 4 BAND KITS

Spectacular is the only way to describe these new four band add on kits for the A3 and A4 beams. Why have just another three band beam when with this simple addition you can have a Cushcraft "four bander"? You'll operate 40 meters or, with a simple adjustment, the new 10 MHz WARC band. With the bi-directional pattern you'll be able to pinpoint those regular contacts and DX stations.

The kits are complete with stronger center insulator, new Teflon® protected high power traps, all hardware and non stretch lamcord® support line. They can be quickly and simply clamped to your three or four element Cushcraft beam.

A743 7MHz 10MHz kit for A3
A744 7MHz 10MHz kit for A4

A743 & A744	**7MHz (40m)**	**10MHz (30m)**
Driven Element with Adapter kit, ft (m)	33-2¼ min. 35-4 max. (10.12 to 10.77)	27-1½ min. 28-4¾ max. (8.27 to 8.66)
Windloading, ft²	.58	.27
(m²)	(.05)	(.03)
Bandwidth, KHz	125	150
Power Rating, Watts	2000 PEP	
Side Rejection, dB	20	20
Weight, lb (kg)	3.44 (1.56)	2.29 (1.04)

A3 WORLD RANGER 3 ELEMENT BEAM 10, 15, 20 METERS

Dynamite in a small package! A3 is a real power house beam with plenty of gain and front to back ratio to handle the pile-ups on your favorite DX bands. The heavy duty traps have enough reserve for a high power linear. All of this performance is yours with a clean profile beam that can be mounted on a light weight tower and rotator in a very small space. Its rugged design features quality components like galvanized and stainless steel clamps, zinc plated U-bolts, fiberglass insulators and heavy wall tubing.

You'll be pleased at the ease of assembly because we have designed out unnecessary hardware and given you a fully illustrated instruction manual. Proven in DX-peditions and contests, A3 has become the world standard for 3 element beams.

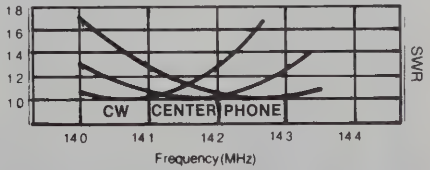
Forward Gain	8 dBd
Front to Back Ratio, Avg	25 dB
SWR	1.2-1 Typical
Bandwidth, Avg KHz	500
Power Rating, Watts	2000 PEP
Feed Point Impedance	50 Ohms
Connector	Twin terminal stainless
No Balun Required	steel takes all coax.
Hardware	Zinc Plated Steel
Boom, ft	14 × 1.63 – 1.50
(cm)	(426.7 × 4.13 – 3.81)
Longest Element & diameter, ft	27.75 × 1.13 – .50
(cm)	(845.8 × 2.86 – 1.27)
Wind Surface Area, ft² (m²)	4.36 (0.47)
Turning Radius, ft (m)	15.50 (4.72)
Mast Diameter, in	1.25 min. 2 max.
(cm)	(3.18 to 5.08)
Material	6063-T832 Seamless Aluminum
Telescope Method	Taper tubing with full circle clamps
Weight, lb (kg)	27 (12.9)

STAINLESS STEEL KITS

Convert your beam to all stainless steel hardware to eliminate the possibility of rust or corrosion. Excellent for antennas used near salt water or industrial areas. The kit includes all necessary clamps, U-bolts and fasteners.

A3 YAGI KIT = A3SK A4 YAGI KIT = A4SK

TYPICAL A3 SWR GRAPH

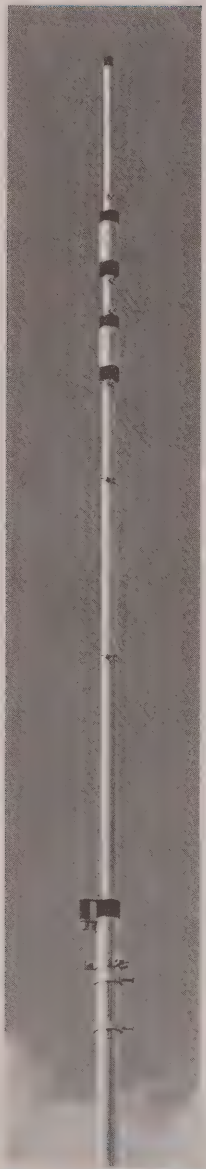


World Ranger Beams are broadband to operate with all solid state transceivers.

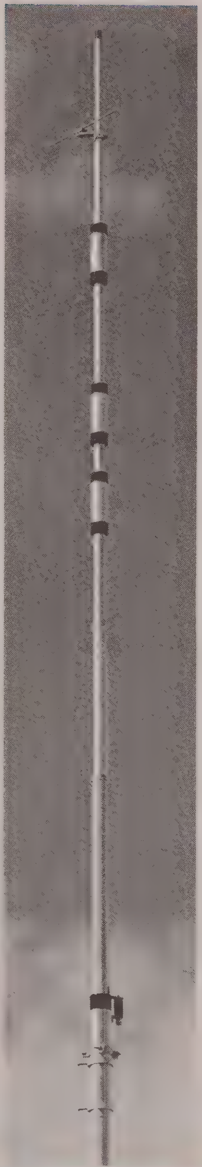
cushcraft R3

THE ONLY NO RADIAL VERTICAL

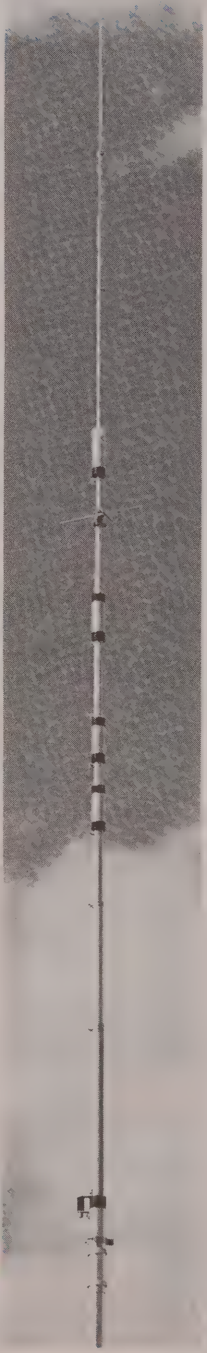
AV3



AV4

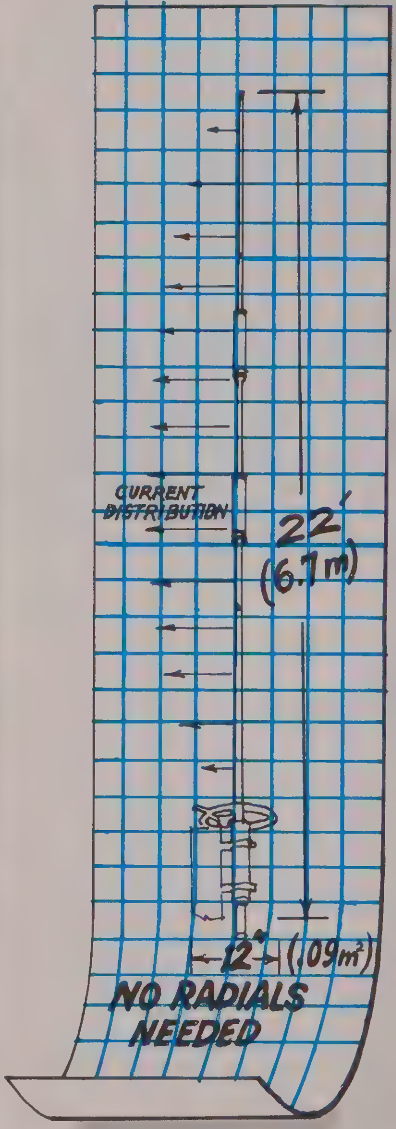


AV5



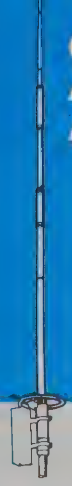
HF LASER

Multiband Verticals



R3

THE COMPLETE ANTENNA SYSTEM

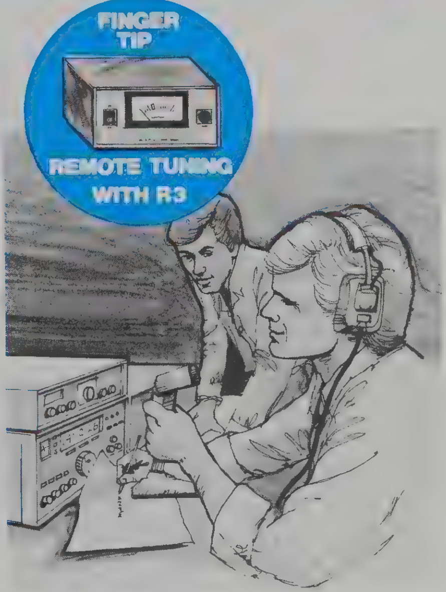


OWN THE WORLD WITH THE AMAZING R3 VERTICAL ANTENNA. 10, 15, 20 METERS

cushcraft HF LASER

Multiband Verticals

R3



THE AMAZING R3 VERTICAL

The R3 half wavelength design eliminates the ground radial system required by other verticals. Optimum current distribution gives more efficiency and low angle radiation for DX communications.

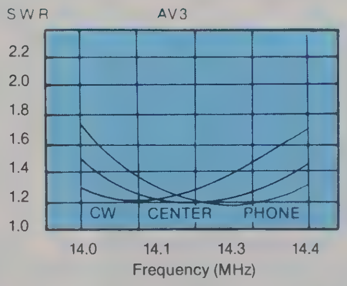
R3 brings high performance antenna features to those living in apartments, condominiums or on small city lots. Even if you have plenty of space, R3's combination of neat appearance and DX capability make it ideal for your station. The R3 includes an integral tuner to give a perfect match across 10, 15, and 20 meters. The remote tuning feature allows easy fingertip control as you operate your station.

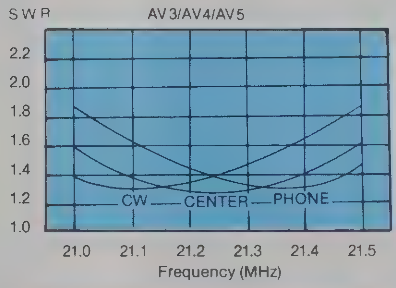
R3 is a complete antenna system ready to install in virtually any location from ground level to roof top.

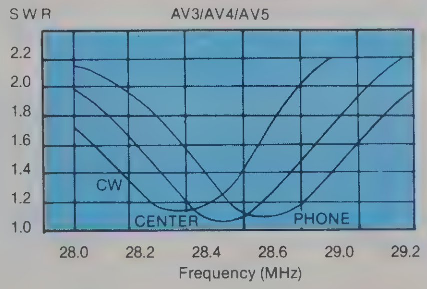
FEATURES

3 dB Gain, ref ¼ λwhip
No Radials
360° Coverage
Integral Tuner with
Remote Control Console and Indicator
24 Volts To Tuner
110 or 220 Volt Operation
Power Handline Capablility 2,000 Watts PEP
75 ft (22.9m) Control Cable Included
Only 22 ft (6.7m) High
1 sq ft (.09 sq m) Space
Self Supporting
Stainless Steel Hardware
Mount: Sleeve Type Fits Pipe Up To
1¾ in (4.5 cm) dia
Can Be Easily Stored and Set Up For
Portable or Temporary Operation

Add up the features—you'll find that you can have ALL OF THIS PERFORMANCE without the need to buy tower, rotator and associated hardware. **R3 is another product created for the enjoyment of your hobby by the world renowned Cushcraft engineering design team.**







HF LASERS are the high performance economical antenna for today's active multiband station. HF LASERS should be your first choice for operating flexibility with little investment. HF LASERS cover the entire band on 40, 20, 15 and 10 meters. Consider the advantages of having 70 KHz plus at your finger tips on 80 meters. Automatic switching, broadband enclosed traps and stainless steel hardware are standard. HF LASERS are all-weather antennas that will survive hurricane force winds.

Your HF LASER may be roof or ground mounted. A good ground radial system is recommended. In some cases a simple ground rod will be sufficient.

AV5 Work all popular HF bands

Frequency Range, meters	80, 40, 20, 15, 10
SWR	Less than 2:1 80>70 KHz
Height, ft (m)	25 (7.4)
Mount, in (cm)	Sleeve, 1.75 (4.5)
Power Capability, Watts	2000 PEP
Wind Survivability, mph (kph)	80 (130) plus
Radiator	6063-T832 alum.
Element Diameter, in (cm)	1.375 (3.5) max.
Connector	S0239

AV4 Excellent 40 meter coverage

Frequency Range, meters	40, 20, 15, 10
SWR	Less than 2:1
Height, ft (m)	19 (5.9)
Mount, in (cm)	Sleeve, 1.75 (4.5)
Power Capability, Watts	2000 PEP
Wind Survivability, mph (kph)	80 (130) plus
Radiator	6063-T832 alum.
Element Diameter, in (cm)	1.375 (3.5) max.
Connector	S0239

AV3 Three popular DX bands

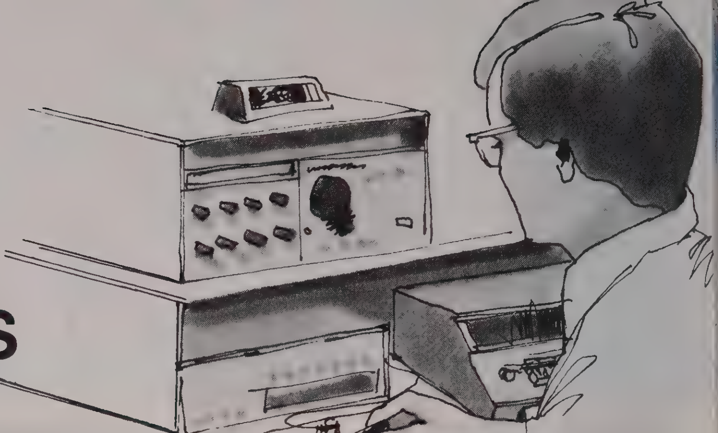
Frequency Range, meters	20, 15, 10
SWR	Less than 2:1
Height, ft (m)	14 (4.2)
Mount, in (cm)	Sleeve, 1.75 (4.5)
Power Capability, Watts	2000 PEP
Wind Survivability, mph (kph)	80 (130) plus
Radiator	6063-T832 alum.
Element Diameter, in (cm)	1.375 (3.5) max.
Connector	S0239

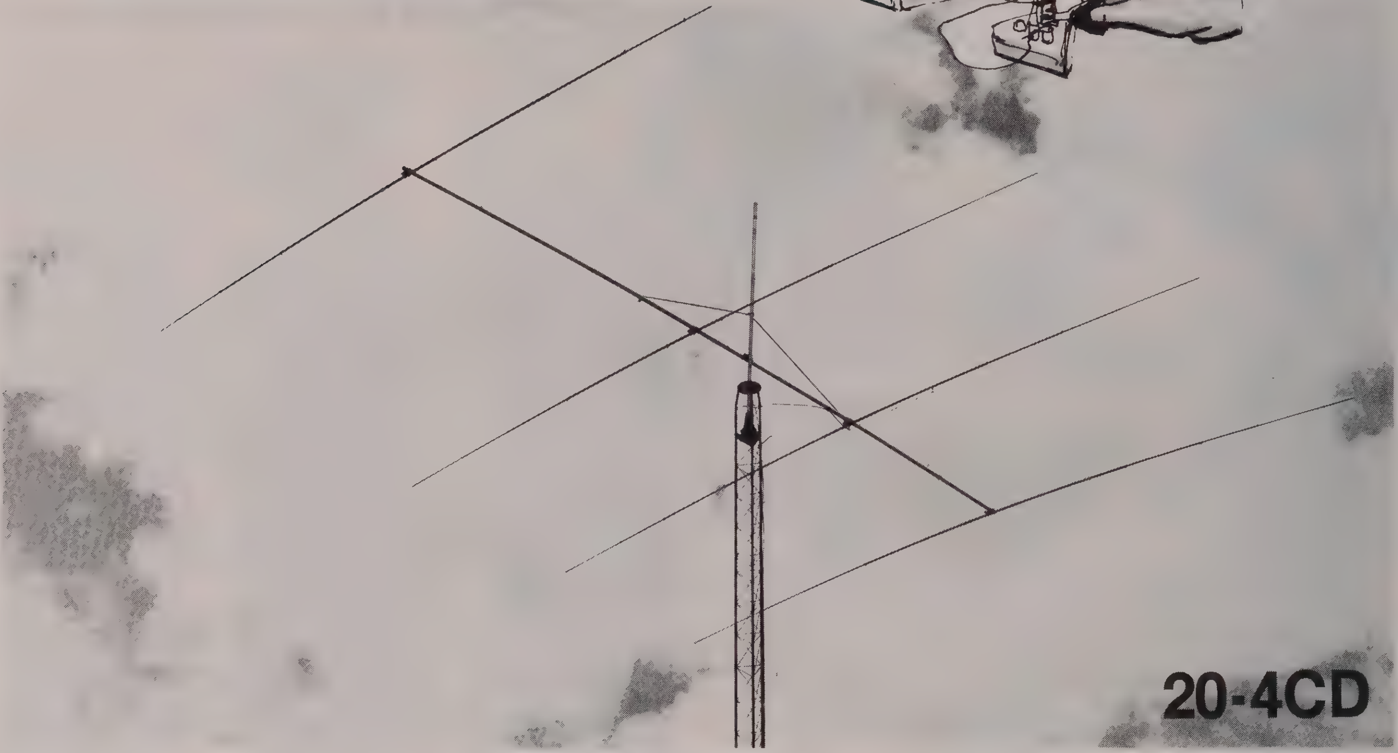
NEW! AWV3 Complete WARC band coverage

Frequency Range, meters	30, 16, 12
SWR	Less than 2:1
Height, ft (in)	17.6 (5.4)
Mount	Stud
Power Capability, Watts	2000 PEP
Wind Survivability, mph (kph)	80 (130) plus
Radiator	6063-T832 alum.
Element Diameter, in (cm)	1.125 (2.5) max.
Connector	Stainless steel

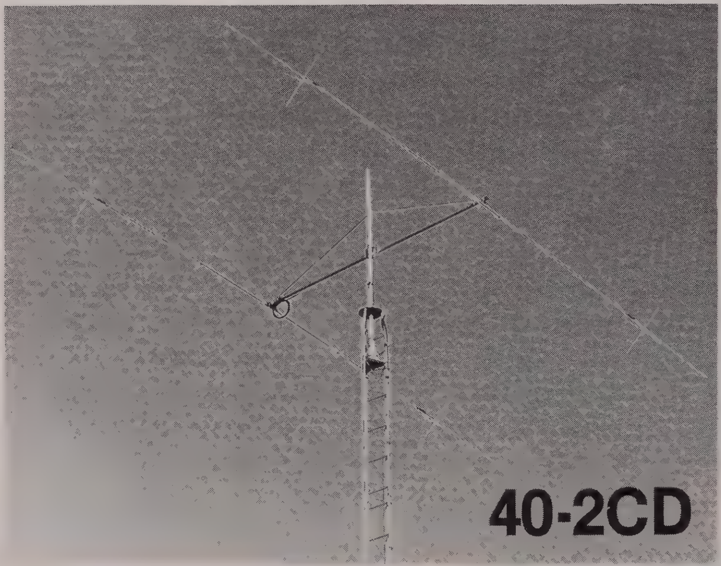
PROVEN CONTEST WINNERS
THAT GIVE YOU MORE PERFORMANCE
IN LESS SPACE

cushcraft
SKYWALKER HF YAGIS

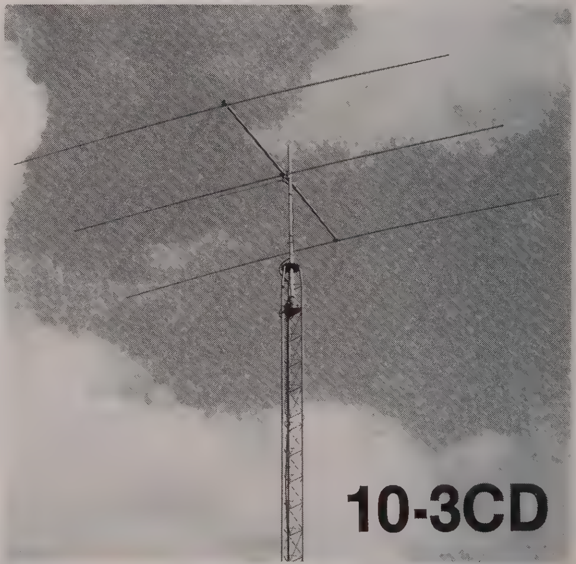




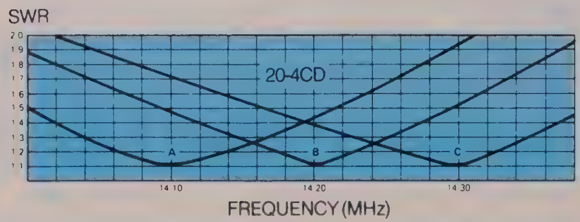
20-4CD

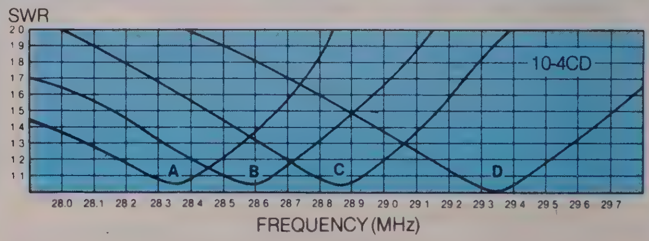


40-2CD



10-3CD





FOR MORE CONTACTS

TRY OUR HIGH PERFORMANCE 2 ELEMENT 40 METER BEAM.

cushcraft

40, 20, 15, 10 METERS

HF YAGIS
40, 20, 15, 10 METER

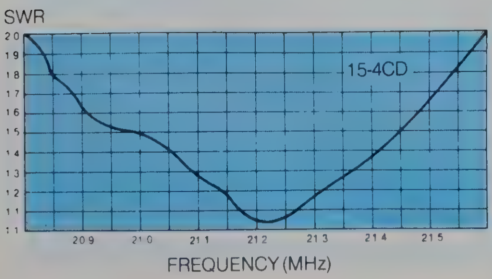
More contacts, less waiting, less interference, and a better signal at the other end are yours with the Skywalker series of computer design single band Yagis. Skywalkers are based on a FORTRAN program which allowed Cushcraft engineers to maximize the gain while minimizing sidelobes and SWR. The 10 dBd forward gain of the 4 element models and 8 dBd of the 3 element version will put you first in line. Either type may be stacked for additional gain.

Construction features for all models include heavy wall heat treated 6063-T832 aluminum tubing, rugged stainless steel fasteners, worm drive element clamps, and carefully formed aluminum brackets. Assembly is simple with the new Cushcraft boom assembly marking system. The high strength, lightweight aluminum often allows one-man installation and rugged construction insures easier assembly and long life. Skywalkers are used by major DX and contest stations around the world.

40 METER

Holder of the North American 7 MHz contact record. This compact two element antenna has quickly become "the most wanted" 40 meter beam. It should be your first choice.

MODEL	40-2CD
Frequency, MHz	7.0-7.3
Forward Gain, dBd	5.5
F/B Ratio, dB	20
Boom Length, ft	23
(m)	(6.9)
Boom Dia., in	2.13-1.88
(cm)	(5.4-4.8)
Longest Element, ft	43
(m)	(12.9)
Element Dia., in	1.25-.5
(cm)	(3.1-1.3)
E-plane B/width, deg	70
Side Lobe Attenuation, dB	25
1.5-1 SWR Bandwidth, KHz	180
Turning Radius, ft	23.93
(m)	(7.29)
Windload, ft²	6.38
(m²)	(.57)
Weight, lb	40.68
(kg)	(18.3)



20 METER

Enjoy the all-out performance of four elements on a 32 ft (9.75 m) boom, or if your space is limited, use our compact three element beam. Both antennas are designed to punch your signal through on this very active band.

MODEL	20-4CD	20-3CD
Frequency, MHz	14.0-14.35	14.0-14.35
Forward Gain, dBd	10.0	8.0
F/B Ratio, dB	30	30
Boom Length, ft	32	18
(m)	(9.75)	(5.49)
Boom Dia., in	2.13-1.88	2.13-1.88
(cm)	(5.4-4.8)	(5.4-4.8)
Longest Element, ft	35.83	35.66
(m)	(10.92)	(10.87)
Element Dia., in	1.25-.50	1.25-.50
(cm)	(3.1-1.3)	(3.1-1.3)
E-plane B/width, deg	60	56
Side Lobe Attenuation, dB	40	40
2-1 SWR Bandwidth, KHz	400	300
Turning Radius, ft	23.75	20
(m)	(7.2)	(6.1)
Windload, ft²	8.1	5.5
(m²)	(.75)	(.51)
Weight, lb	55	30
(kg)	(24.95)	(13.61)

15 METER

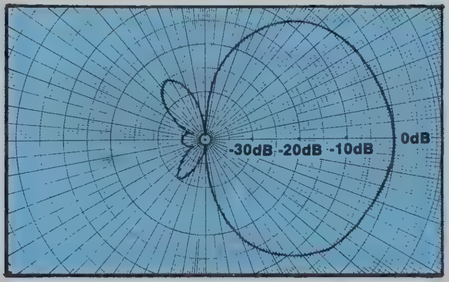
Here are two exciting Skywalker beams for the fifteen meter enthusiast. If you demand maximum gain, make your choice the four element. You may want to try stacking the three element models.

MODEL	15-4CD	15-3CD
Frequency, MHz	21.0-21.45	21.0-21.45
Forward Gain, dBd	10.0	8.0
F/B Ratio, dB	30	30
Boom Length, ft	20	14
(m)	(6.10)	(4.27)
Boom Dia., in	2-1.63	1.88-1.63
(cm)	(5.1-4.1)	(4.8-4.1)
Longest Element, ft	23.33	23.16
(m)	(7.11)	(7.06)
Element Dia., in	1-.63	1-.63
(cm)	(2.5-1.6)	(2.5-1.6)
E-plane B/width, deg	57	56
Side Lobe Attenuation, dB	40	40
1.5-1 SWR Bandwidth, KHz	500	500
Turning Radius, ft	15.5	13.50
(m)	(4.72)	(4.11)
Windload, ft²	4.5	3.4
(m²)	(.42)	(.32)
Weight, lbs	25	20
(kg)	(11.34)	(9.07)

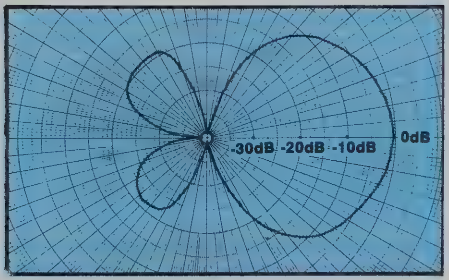
10 METER

Work the world with either one of these easy to use antennas. You'll enjoy all of the benefits of a high performance antenna system with our easy to assemble designs.

MODEL	10-4CD	10-3CD
Frequency, MHz	28.0-29.7	28.0-29.7
Forward Gain, dBd	10.0	8.0
F/B Ratio, dB	30	30
Boom Length, ft	17	12
(m)	(5.18)	(3.66)
Boom Dia., in	1.75-1.50	1.63-1.50
(cm)	(4.4-3.8)	(4.1-3.8)
Longest Element, ft	17.83	17.66
(m)	(5.43)	(5.38)
Element Dia., in	.88-.63	.88-.63
(cm)	(2.2-1.6)	(2.2-1.6)
E-plane B/width, deg	57	56
Side Lobe Attenuation, dB	40	40
1.5-1 SWR Bandwidth, KHz	600	700
Turning Radius, ft	14	10
(m)	(4.27)	(3.05)
Windload, ft²	3.1	2.3
(m²)	(.29)	(.21)
Weight, lbs	18	11
(kg)	(8.16)	(5.00)

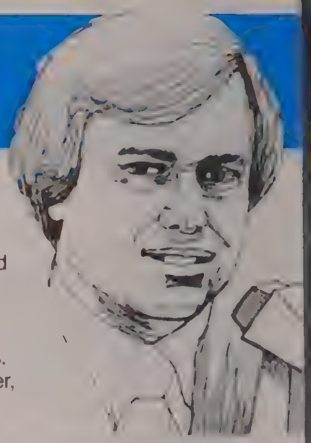


Typical 4 Element Pattern



Typical 3 Element Pattern

TWO NEW HIGHER PERFORMANCE 2 METER BOOMERS 215 WB AND 4218 BOOMER XL

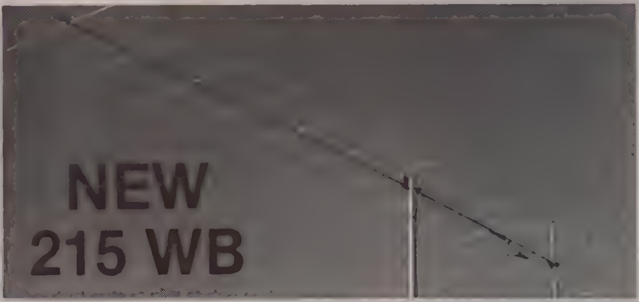


cushcraft

BOOMERS

The Contest Winners

Antennas so efficient, powerful, and successful that they defy comparison. They have won every antenna measuring contest in which they have been entered. They have established new EME contest record scores. Boomer's computer based design has become the standard of comparison for others to copy. Listen on any VHF or UHF band, you'll hear experienced, knowledgeable hams using high performance Boomer antennas. Be prepared, Tropo scatter, E skip, meteor scatter, aurora, EME and VU Century Club will be yours with a Cushcraft Boomer.



BOOMER STACKING INFORMATION

Antenna	2X617-6B	2X215WB	4X215WB	2X32-19	4X32-19	2X220B	4X220B	2X424B	4X424B	2X4218XL	4X4218XL
Forward Gain, dBd	16.6	18.5	21.5	18.8	21.2	19.8	22.4	20.8	23.4	20.2	23.2
Front/Back Ratio, dB	30	24	24	24	24	30	30	30	30	24	24
E-Plane Beamwidth, deg	2X17.5	2X17	2X8.5	2X14	2X7.5	2X13	2X6.5	2X9.5	2X4.8	2X13	2X6.5
H-Plane Beamwidth, deg	2X10	2X9	2X9	2X8.5	2X7	2X7	2X5.5	2X5.5		2X7.25	2X7.25
Stacking Distance											
Vert, ft	26	10	10	12	12	8	8	5.0	5.0	12.63	12.63
(m)	7.92	3.05	3.05	3.66	3.66	2.44	2.44	1.97	1.97	3.85	3.85
Horiz, ft	—	—	10	—	13	—	8.5	—	5.5		13.38
(m)	—	—	3.05	—	3.96	—	2.59	—	2.16		4.08
Approximate Weight, lb	62	22	44	26	97	23	76	16	55	32.5	115
(kg)	28.12	10.00	20.00	11.79	44.00	10.40	34.40	7.26	24.95	14.8	52.3

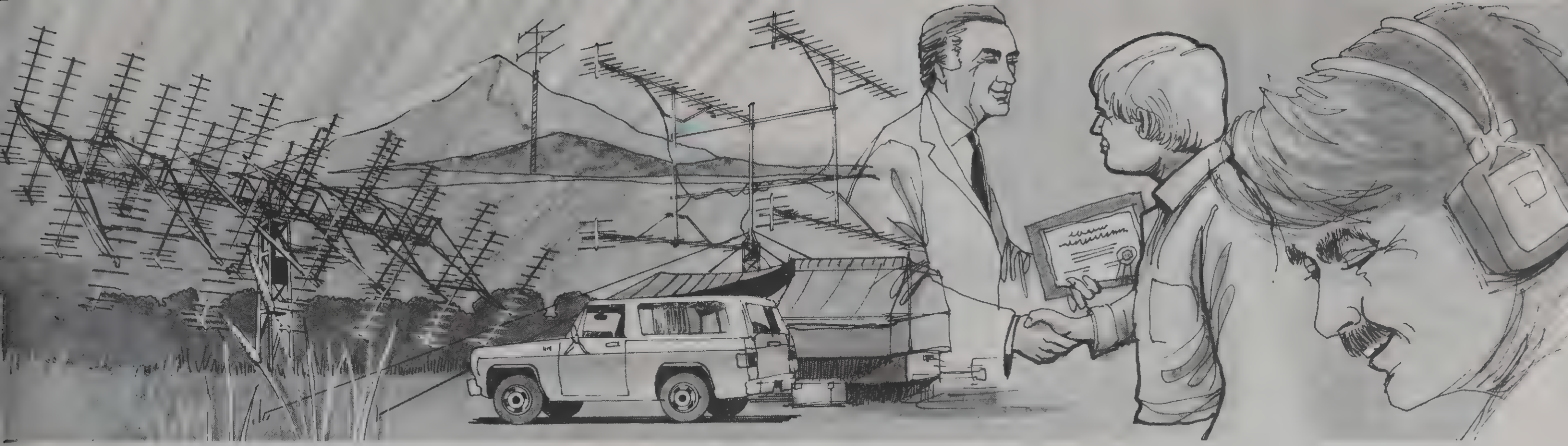
811

EGE - 859.95 (NO TRANS)

Amateur Electronics	839.95 +6
Tone	34.95
Voice	39.95
SP.430	44.95

C-Com - 919

HamRadio 899.95
Outlet



2 METER

Develop new friendships explore new horizons and achieve new levels of operating success, with any one of three exciting Boomer models for 2 meters.

Boomer XL is "the antenna for 2 meter DX". More than 3 years of design, antenna range tests, and on-the-air contesting have been combined to produce the 4218XL's higher gain and cleaner pattern. This antenna is designed to survive. It features step tapered boom, tubular support braces and all stainless steel hardware. The new 4218XL is the only antenna with this great combination of features to make your 2 meter activity more successful and satisfying.

The band is at your command with 32-19 which has very high gain on a 22 foot 3.2 boom. A perfect choice antenna where space is not available for the longer XL.

The 215WB features the latest in wideband technology. Whatever your favorite 2 meter mode may be, the 215WB will give you excellent gain and pattern horizontally or vertically polarized.

All Boomer models above 6 meters have solid rod elements, hard drawn 6063-T832 aluminum tubing booms and stainless steel hardware. They also feature trigon reflectors, balanced T-Match feed system including 50 ohm coaxial baluns. The fully detailed manuals with help to put you on the air quickly and easily. Enjoy your hobby more with a Cushcraft Boomer.

MODEL	32-19	4218XL	215WB
Frequency Range MHz	144-146	144-145	144-148
Forward Gain dBd	16.2	17.2	15.5
Front/Back Ratio dB	24	24	24
Boom Length ft, (cm)	22 (6.71)	28.8 (8.78)	15 (5.57)
Wavelength	3.2	4.2	2.2
Number of Elements	19	18	15
SWR Typical	1.2:1	1.2:1	1.2:1
Impedance, Ohms	50	50	50
Beam Width, deg.			
E-Plane	2×14	2×13	2×17
H-Plane	2×17	2×14.5	2×18
Side Lobe Attenuation, dB	60	60	60
Turning Radius ft (m)	11 (3.35)	16.66 (5.08)	7.5 (2.29)
Wind Load, ft² (m²)	3.5 (3.3)	3.5 (3.3)	1.7 (.16)
Weight, lb (kg)	12 (5.44)	14.3 (6.5)	8 (3.63)

POWER DIVIDERS

PD-2	Power Divider, 2, 32-19, 215WB or 4218XL
PD-4	Power Divider, 4, 32-19, 215WB or 4218XL
PD-222	Power Divider, 2, 220B
PD-224	Power Divider, 4, 220B

6 METER

The 617-6B has more gain than any other 6 element 6 meter antenna. The 34 foot boom puts it in a class by itself. With Boomer's 14 dB gain you will be the first one through when the band opens. The 617-6B Boomer, using the latest in computer design technology, is designed for the serious 6 meter operator.

MODEL	617-6B
Frequency Range, MHz	50-51
Forward Gain, dBd	14.0
Front/Back Ratio, dB	30
Boom Length, ft (m)	34 (10.36)
Wavelength	1.7
Number of Elements	6
SWR Typical	1.2:1
Impedance, Ohms	50
Beamwidth, deg	
E-Plane	2 × 19
H-Plane	2 × 20
Side Lobe Attenuation, dB	60
Longest Element, ft (m)	9.5 (2.89)
Turning Radius, ft (m)	17.7 (5.39)
Windload, ft² (m²)	4.8 (.45)
Weight, lb (kg)	26 (11.79)

1¼ METER

All of the features that have made the 2 meter Boomers tops on their band have been incorporated into the 220B, 1¼ meter Boomer. Join the excitement on our fastest growing amateur band. Let Cushcraft's 220B make your adventure more enjoyable.

MODEL	220B
Frequency Range, MHz	220-223
Forward Gain, dBd	17.2
Front/Back Ratio, dB	30
Boom Length, ft (m)	19 (5.8)
Wavelength	4.2
Number of Elements	17
SWR Typical	1.2:1
Impedance, Ohms	50
Beamwidth, deg	
E-Plane	2 × 13
H-Plane	2 × 14
Side Lobe Attenuation, dB	60
Turning Radius, ft (m)	9 (2.64)
Windload, ft² (m²)	2.6 (.24)
Weight, lb (kg)	10.5 (4.77)

STACKING FRAMES AND HARNESSES

Antennas Being Stacked	Select Kit Model	Kit Description
617-6B (2 ants.)	617-SK	Harness and Power Divider
215 WB (2 ants.)	22-SK	Harness and Power Divider
215 WB (4 ants.)	224QK	H-frame, Harness, and Power Dividers
32-19 (2 ants.)	32SK	Harness and Power Divider
32-19 (4 ants.)	324QK	H-frame, Harness, and Power Dividers
220B (2 ants.)	220SK	Harness and Power Divider

70 CM

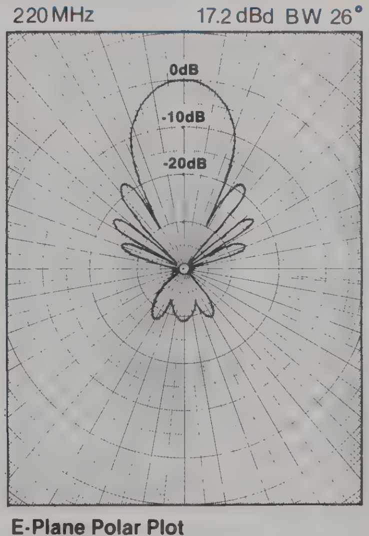
The dynamic duo for 432. Through the boom insulated elements, precise spacing and high efficiency reflector systems are important to you. They are the features that make the 70 CM Boomer a must. Choose from two contest winning models: the rear mounted 410B with 15.0 dBd forward gain or the band opening 424B, 7.6 wavelength 18.2 dBd gain Boomer.

Here is why you can expect years of service from a 70 CM Boomer. All stainless steel hardware including non-slip element retainers, ultraviolet stabilized element insulators, teflon dielectric coaxial balun, weather resistant low loss N connector, and seamless heavy wall boom material with stainless steel locking pins.

These antennas have proven themselves in gain measuring contests and on the air activities. Accept the challenge of technology! Step up to a new 70 CM Boomer.

MODEL	424B	410B
Frequency Range, MHz	424-435	424-435
Forward Gain, dBd	18.2	15.0
Front/Back Ratio, dB	30	21
Boom Length, ft (m)	17.4 (5.3)	6 (1.8)
Wavelength	7.6	2.2
Number of Elements	24	12
SWR Typical	1.2:1	1.2:1
Impedance, Ohms	50	50
Beamwidth, deg		
E-Plane	2 × 9.5	2 × 16.5
H-Plane	2 × 11	2 × 14.5
Side Lobe Attenuation, dB	60	60
Turning Radius, ft (m)	10 (3.05)	5.66 (1.73)
Windload, ft² (m²)	2.3 (.21)	.65 (.06)
Connector, Type 50 Ω	N	N
Weight, lb (kg)	6.66 (3.03)	4.5 (2.05)

TYPICAL RADIATION PATTERN



E-Plane Polar Plot
220B Boomer

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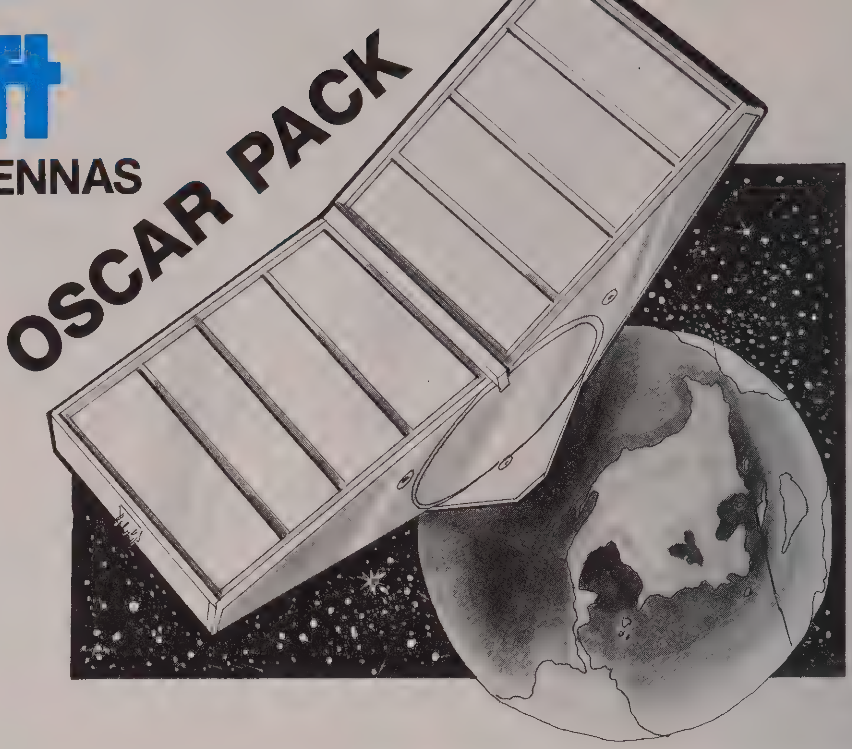
OSCAR SATELLITE ANTENNAS



OSCAR THE EASY WAY

Assembling an OSCAR station is a big job. Cushcraft has made it a lot easier....That's exciting news for hams around the world. A complete Oscar antenna system in one box is yours with the AOP-1. You get the 416TB uplink, the A144-20T downlink, and the A14-TMB mounting boom, all the OSCAR antenna you'll ever need. These BOOMER antennas provide leading performance for both the uplink and downlink functions. The uplink features insulated elements, T-matched twin driven elements, built-in baluns, special phasing harnesses, rear boom mount, and stainless steel hardware. This amazing antenna has true circular polarization right or left, and 12.5 dBd gain to give an extra margin of radiated power to the satellite.

The two meter antenna has been proven by many thousands of amateur satellite contacts from the first OSCAR through the current model. It features excellent performance plus ease of assembly and installation. this crossed Yagi incorporates electrically separated high gain arrays resulting in left or right selectable circular polarization. Each system includes necessary delay lines and connectors. Assembly is simple with the comprehensive instructions supplied. One afternoon is all that is needed to assemble your complete AOP-1 system.

	10 Element	20 Element	16 Element
MODEL	A144-10T	A144-20T	416TB
Frequency, MHz	145.9	145.9	435
2:1 SWR Bandwidth, MHz	>2	>1.5	>3
Forward Gain, dBd	10.5	12.2	12.5
3-dB Beamwidth, deg	52	38	34
F/B Ratio, dB	20	20	20
Boom Length, in (m)	70 (1.8)	130 (3.3)	80 (2.03)
Longest in Element, (m)	40 (1.0)	40 (1.0)	13.3 (.34)
Wind Area, ft² (m²)	.74 (.07)	1.42 (.13)	.5 (.046)
Weight, lb (kg)	3.5 (1.6)	6.6 (3.0)	4.9 (2.2)
Max Mast OD, in (cm)	1.50 (3.8)	1.50 (3.8)	2.0 (5.0)

OSCAR Pack is your key to enjoyment of the latest phase of worldwide amateur satellite communications.

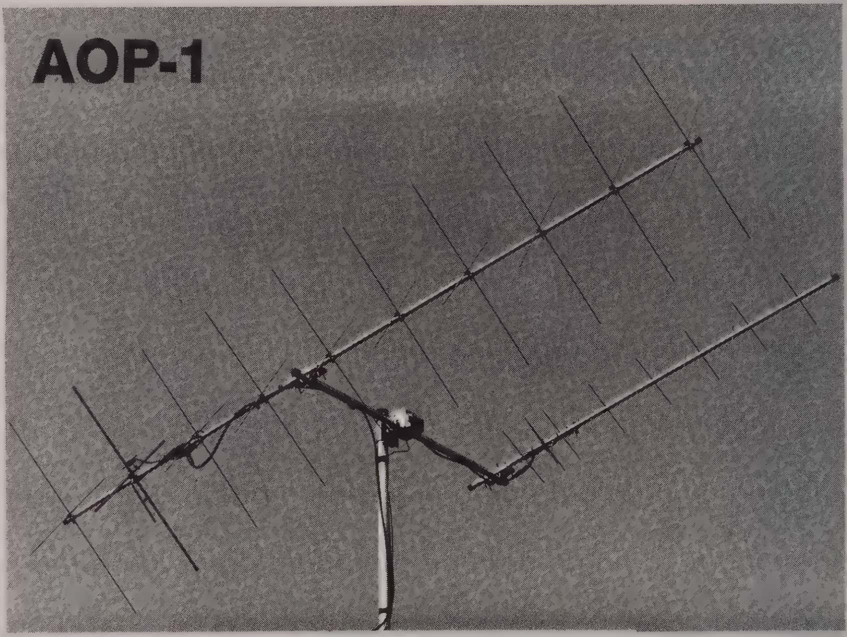
OSCAR MOUNTING BOOM

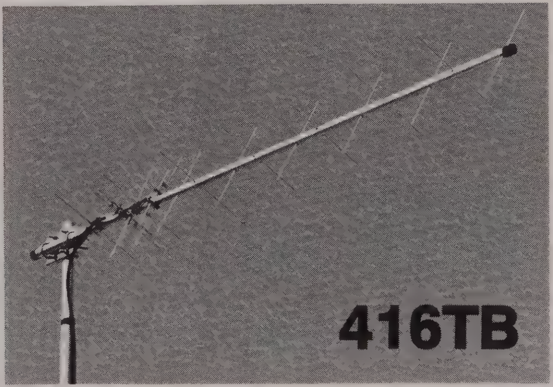
You can mount 2 meter and 70 cm twist antennas on the A14T-MB mounting kit. It has a 4.2 ft (1.3m) support boom with mount plate for the U100 elevation rotator. The easy way to a complete OSCAR station.

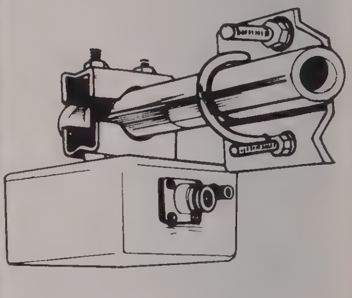
NEW OSCAR POLARITY SWITCHER PS4

Oscar operation will be more fun with this remote polarity switch mounted on the 416TB. You will access satellites having either circular left or right polarization.

Frequency, MHz	430-440
Input Impedance	50 Ω
SWR	< 1.5:1
Power Handling Watts, cw	100
Coaxial Connector	N female
12 volt DC input	Phono jack, RCA
Size, in	4.6 × 3.6 × 2.3
(cm)	(12 × 9 × 6)
Boom Mount	U-bolt
Weight, lb (kg)	2.5 (1.0)






Remote Switching

COMING SOON, TWO METER REMOTE SWITCH MODEL PS2

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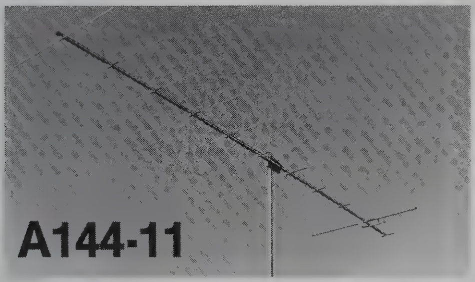
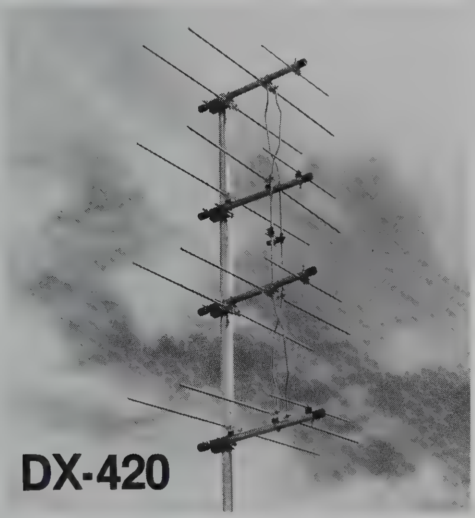
POPULAR VHF/UHF ANTENNAS

LEADERS IN THE HOBBY FOR MORE THAN 30 YEARS

A50-5


A144-11


DX-420

6 METER BEAMS

Share the excitement of increased 6 meter activity with Cushcraft high performance antennas.

There are model choices available for every ham need. They will give you years of high performance and trouble free service.

MODEL	A50-3	A50-5	A50-6
Elements	3	5	6
2:1 SWR Bandwidth, MHz	>1	>1	>1
Gain, dBd	8	10.5	11.2
F/B Ratio, dB	20	22	24
3-dB Beamwidth, deg	76	56	48
Boom Length, ft (m)	6 (1.8)	12 (3.7)	20 (6.1)
Longest Element, in (m)	117 (3.0)	117 (3.0)	117 (3.0)
Turning Radius, ft (m)	6 (1.8)	7.50 (2.3)	11 (3.4)
Wind Area, ft^2 (m^2)	1.80 (.17)	2.74 (.25)	4.46 (.41)
Max Mast OD, in (cm)	1.50 (3.8)	1.50 (3.8)	2.0 (5.1)
Weight, lb (kg)	7 (3.2)	11 (5.0)	18 (8.2)

1¼, 2 METER AND 70 CM BEAMS

You'll be amazed at your rig's performance with any one of these lightweight and durable antennas that are budget priced. They feature evenly spaced, tapered elements for better bandwidth, plus the easy tune Reddi Match for direct 50 ohm feed. The SO-239 fitting has a moisture sealing vinyl boot. You'll be on the air in one easy afternoon.

MODEL	A144-7	A144-11	A220-11	A430-11
Frequency, MHz	144-146	144-146	220-225	430-435
Elements	7	11	11	11
2:1 SWR Bandwidth, MHz	>3	>3	>5	>10
Gain, dBd	11.1	13.2	13.2	13.2
F/B Ratio, dB	20	20	20	20
3-dB Beamwidth, deg	46	38	38	38
Boom Length, in	98	144	102	56
(m)	(2.5)	(3.7)	(2.6)	(1.4)
Longest Element, in	40.25	40.25	26.25	14
(m)	(1.0)	(1.0)	(.67)	(.35)
Turning Radius, in	59	81	57	32
(m)	(1.5)	(2.0)	(1.4)	(0.81)
Wind Area, ft^2	0.81	1.21	0.84	0.42
(m^2)	(0.08)	(0.11)	(0.08)	(0.04)
Max Mast OD, in	1.50	1.50	1.50	1.50
(mm)	(38)	(38)	(38)	(38)
Weight, lb	4	6	4	3
(kg)	(1.8)	(2.7)	(1.8)	(1.4)

DX-ARRAYS 1¼, 2 METER 70 CM

Looking for a versatile antenna to use for ATV, EME, FM or DX-ing the new VUCC? DX-Arrays may be the perfect choice for you. The phased collinear elements give excellent gain and broadband coverage for your favorite activity.

MODEL	DX-120	DX-220	DX-420
Frequency, MHz	144-148	220-225	430-440
2:1 SWR Bandwidth, MHz	>4	>5	>8
Gain, dBd	14.0	14.0	14.0
F/B Ratio, dB	18	18	18
3-dB Beamwidth, deg			
E Plane	45	45	45
H Plane	26	26	26
Height, in	118	78	42
(m)	(3.0)	(2.0)	(1.1)
Size: Width, in	75	53	29
(m)	(1.9)	(1.3)	(0.74)
Depth, in	30	20	11
(m)	(0.8)	(0.5)	(0.28)
Turning Radius, in	48	32	18
(m)	(1.2)	(0.8)	(0.46)
Wind Area, ft^2	1.53	0.90	0.64
(m^2)	(.14)	(.08)	(.06)
Weight, lb	8	7	6
(kg)	(3.6)	(3.2)	(2.7)

Support mast not included

1:1 BALUNS

These 1:1 baluns may be used with the DX-Arrays to decouple rf from the coaxial cable.

DX-1BN	DX-2BN	DX-4BN
144-148 MHz	220-225 MHz	430-4340 MHz

YAGI STACKING KITS

Coaxial stacking kits double your effective radiated power by stacking two Yagis. Include RG-59/U cable and connectors, accept PL-259 fitting.

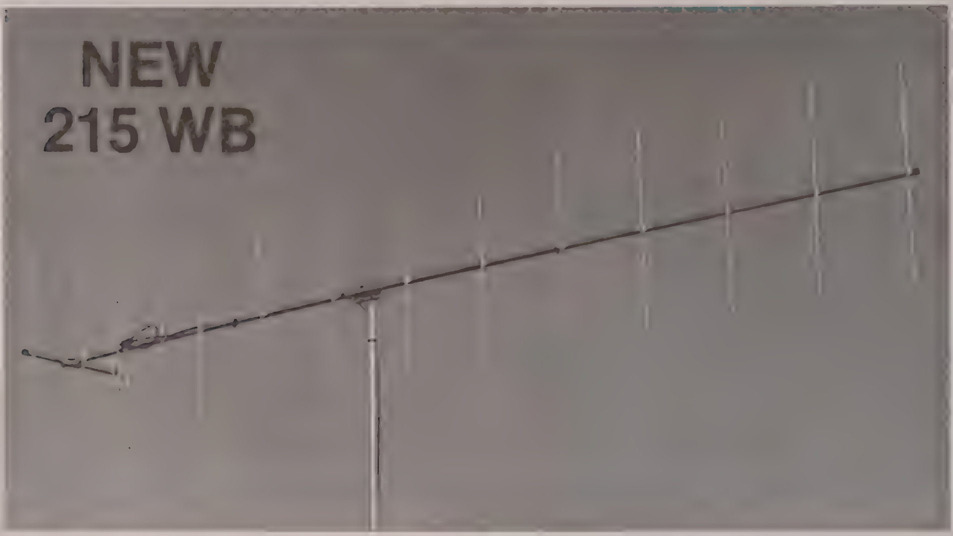
Stacking Kit	For Stacking These Antennas	Stacking in Distance (m)
A535-SK	A50-3 or A50-5	110 (2.8)
A561-SK	A50-6	110 (2.8)
A11-SK	A144-11	79 (2.0)
A17-SK	A144-7	79 (2.0)
A21-SK	A220-11	50 (1.3)
A41-SK	A430-11	26 (.66)

FM PRODUCTS FOR YOU

cushcraft

FM BOOMERS

The Cushcraft 215WB features the latest in Wideband technology. The 215WB is high performance from band-edge to band-edge. Whatever your favorite 2 meter mode may be, the 215WB is for you. Local and distant repeaters on FM, tropo communications on SSB and EME on CW are all easier with the 215WB. Enjoy your hobby more with a 2 meter Cushcraft Wideband Boomer. Harnesses are available for stacking 215WBs in various configurations.



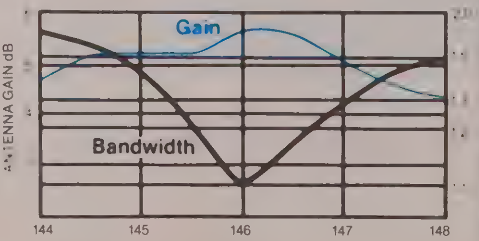
For the highest gain FM antenna in the world, select the 230WB. This array of two 215WB Wideband Boomers in the vertically polarized pair makes FM DX easy. The 230WB includes the antennas, a horizontal support frame, RG8/U cable, power dividers and all stainless steel hardware harnesses.

FM YAGI SPECIFICATIONS

MODEL	215WB	230WB	A147-11	A147-22
Frequency Range, MHz	144-148	144-148	145.5-148	145.5-148
F/B Ratio, dB	24	24	20	20
Forward Gain, dBd	15.5	18.5	13.2	16.2
2:1 SWR Bandwidth, MHz	4	4	3	3
3 dB Beamwidth, deg	36	18	48	42
Boom Length, ft	15	15×11	12	6.6×12
(m)	(4.57)	(4.57)	(3.6)	(2.1×3.6)
Long Element, in	39.5	39.5	40	40
(m)	(1.0)	(1.0)	(1.0)	(1.0)
Turning Radius, ft	7.5	9.5	6	6.6
(m)	(2.29)	(2.9)	(1.8)	(1.5)
Wind Area, ft^2	1.7	4.0	1.21	2.82
(m^2)	(.16)	(.37)	(.11)	(.37)
Max Mast OD, in	2	2	1.50	2
(cm)	(5.0)	(5.0)	(3.8)	(5.0)
Weight, lb	8	22	6	15
(kg)	(3.63)	(9.98)	(2.7)	(6.7)

FM YAGIS

Two antennas have been keys to the growth of FM communication: our eleven element A147-11 and Power Pack A147-22 arrays. Why? Because they combine reasonable size with high levels of value and performance. Assembly is quick and easy, and matching is strictly no problem with the adjustable Reddi Match. Our A147 antennas are favorites with hams across the band today. If you're looking for more solid, reliable contacts for your station, A147-11 and A147-22 are smart thinking.



ANTENNA: ARX 2B FREQUENCY MHZ

WORLD'S MOST POPULAR 2 METER FM ANTENNA

Ranger II

Ringo Ranger II has more gain, less windload, and more mechanical integrity than other 2 meter antennas. You'll find FM, simplex or repeater operation more satisfying with this amazing antenna.

Ringo Ranger II is the latest refinement of the original W1BX Ringo. It has three 5/8λ radiating sections and an adjustable 1/8λ phasing stub. The design gives a very low angle radiation for more realized gain and a solid signal over your entire coverage area. It is the only fully adjustable 2 meter antenna, allowing you to maximize the gain for your QTH.

Ringo Ranger II has a built-in lightning arrester for added safety plus static suppression. The high strength UV stabilized insulators and heavy wall tubing give long term all weather performance. The slim profile design reduces weight and windload on your support mast. Fewer seams, joints, and connections mean no internal noise generation so you will have positive full quieting signals. The 1/4λ decoupling radials eliminate any chance of feedline radiation.

There are more than 500,000 Ringo antennas used worldwide in every possible service. It is this experience that makes the Ringo Ranger II your best antenna choice.

Ringo Ranger II Performance Specifications

Model	ARX-2B	ARX-220B	ARX-450B
Frequency, MHz	134-164	220-225	435-450
2:1 SWR Bandwidth, MHz	>3	>5	>10
Height, in (m)	168 (4.3)	112 (2.8)	59 (1.5)
Wind Area, ft² (m²)	.50 (.05)	.3 (.03)	.2 (.02)
Max Mast OD, in (cm)	1¼ (3.2)	1¼ (3.2)	1 (2.5)
Weight, lb (kg)	6 (2.7)	5 (2.3)	5 (2.3)
Power Rating, Watts	2000	500	500

5.5 dBd Gain 7.0 dB ref. 1/4λ whip

Complete Ham Band Coverage

Low Angle Radiation

Adjustable For Marine, Commercial, Public Service

6063-T832 Aluminum Tubing

Delivers The Performance You Expect

DC Ground For Lightning Protection

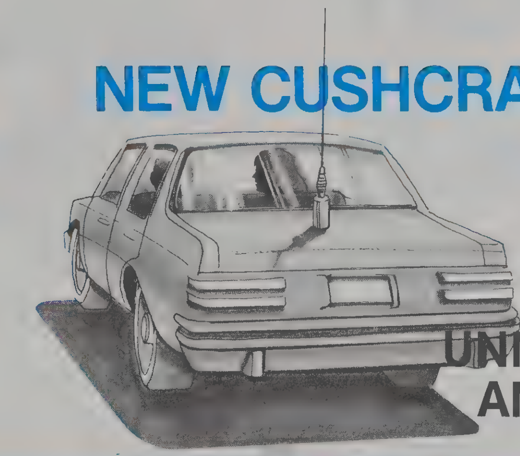
Stainless Steel Hardware

Mounts Easily With Other Antennas

Slim Profile Design

Vinyl Connector Boot

Easy To Assemble

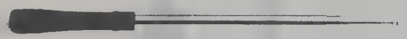


NEW CUSHCRAFT/SIGNALS MOBILE AND PORTABLE ANTENNAS.

UNMATCHED QUALITY AND PERFORMANCE

SIGFLEX WALKIE ANTENNAS

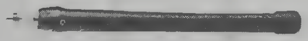
A long, long life at top performance. Whether your choice is the BNC or thread connector you'll be thoroughly impressed by the consistently great results.



2 METER 5/8 3 dB TELESCOPING

UHF 3dB 12 INCH LONG

MINI DUCKS
UHF 2 INCH VHF 3 INCH



UHF AND VHF 6 INCH

CUSHCRAFT/SIGFLEX SELECTOR CHART

Frequency MHz	Connector Type	Model 6 In Duck	Model Mini Duck	Model 3dB Gain
144-148	BNC	BN141	BN141S	BN141W
144-148	5/16-32 Thread	HT141	HT141S	—
220-225	BNC	BN220	BN220S	—
220-225	5/16-32 Thread	HT220	HT220S	—
430-450	BNC	BN440B	BN440C	BN440U
430-450	5/16-32 Thread	HT440B	HT440C	—

MOBILE ANTENNAS

For years the choice for performance and quality of law enforcement, and mobile communications agencies all over the world, Cushcraft/Signals mobile antennas are now on the market for the active ham.

Standard features include silver-plated loading coils...stainless steel...leak proof and shock proof ABS coil cases...non-seizing hardware...RG58 A/U cable, with silver plated coaxial connectors. Every antenna package includes both our straight whip fitting and stainless steel spring for your convenient choice of installation.

3 dB Gain VHF 5/8 λ
5 dB Gain UHF Mobiles

Model No.	Frequency MHz	Whip Length IN	M	Description
CS50M	46-54	49	1.25	Magnetic
CS50T	46-54	49	1.25	Trunk Lip
CS50	46-54	49	1.25	3/4″ Hole
CS147M	144-174	49	1.25	Magnetic
CS147T	144-174	49	1.25	Trunk Lip
CS147	144-174	49	1.25	3/4″ Hole
CS220M	220-225	33	.84	Magnetic
CS220T	220-225	33	.84	Trunk Lip
CS220	220-225	33	.84	3/4″ Hole
CS450M	435-470	29.5	.75	Magnetic
CS450T	435-470	29.5	.75	Trunk Lip
CS450	435-470	29.5	.75	3/4″ Hole

MOUNT OPTIONS

Magnetic Mount
The Cushcraft/Signals 90 pound permanent magnet anchors the antenna to your vehicle.

Trunk Lip Mount
Tops in popularity with the radiophone industry because of its low profile, this Cushcraft/Signals mount is simple to install on your trunk lid or hatchback.

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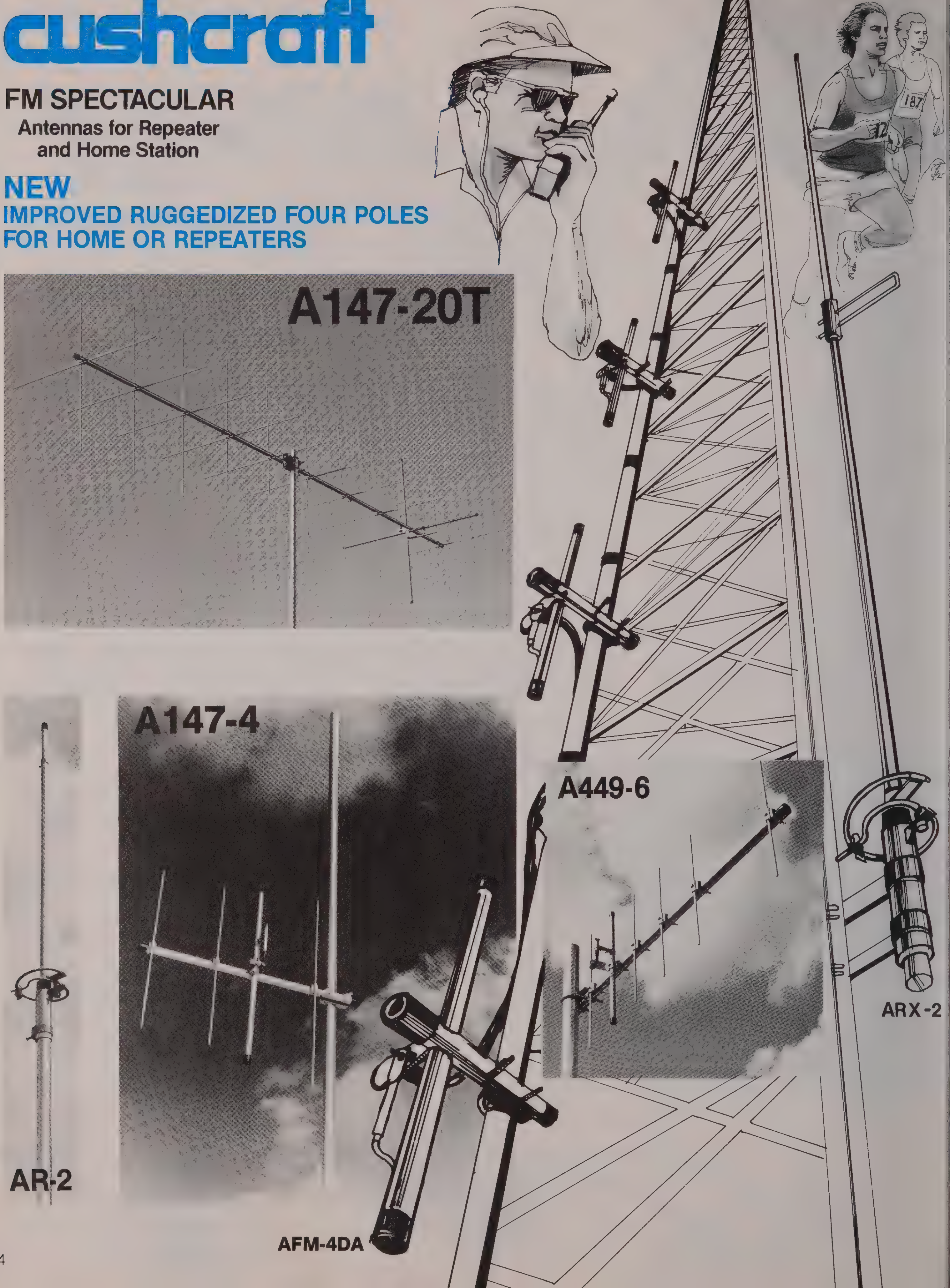
FM SPECTACULAR

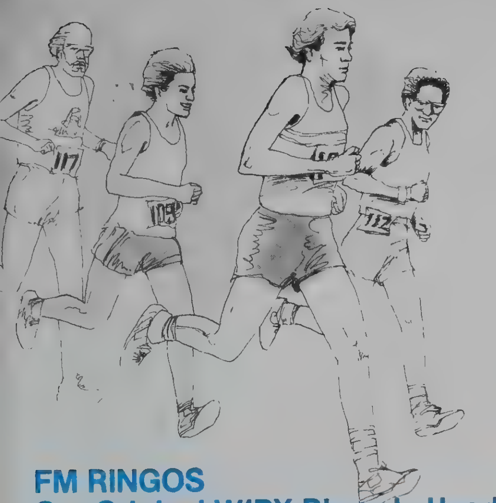
Antennas for Repeater
and Home Station

NEW
IMPROVED RUGGEDIZED FOUR POLES FOR HOME OR REPEATERS



cushcraft

STATION ACCESSORIES



FM RINGOS
Our Original W1BX Ringo Is Used The World Over For Every Possible Service

If you're looking for a combination of compact size and great bandwidth, Ringo ½ λ antennas with 3.75 dB gain can make a lot of sense. Features include a low angle of radiation and direct dc ground for lightning protection.

Our FM Ringos are super easy to assemble and mount, and can even be used indoors when outside mounting space is not available. No radials are needed. There are models for all popular VHF and UHF frequencies.

MODEL	AR-6	AR-2	AR-10	AR-220	AR-450
Frequency, MHz	50-54	135-160	28-29.7	220-225	440-460
2:1 SWR Bandwidth, MHz	2	10	1	10	20
Power Rating, Watts	1000	1000	1000	500	500
Wind Area, ft^2	.37	.21	1.68	.2	.1
(m^2)	(.03)	(.02)	(.17)	(.02)	(.01)
Max Mast OD,in	1.25	1.25	1.25	1.25	1
(cm)	(3.2)	(3.2)	(3.2)	(3.2)	(2.5)

NEW
FOUR POLE ARRAYS

Cushcraft's four ½ λ dipole array is excellent for use as a primary repeater antenna or as a powerful and flexible base antenna. The array gives 6 dBd omni, 9 dBd elliptical gain, it is complete with dipoles, hardware, mounting booms, and harness for 50 Ω feed.

Redesigned with strong through the boom dipole mounting. They direct side mount to tower legs or on a seperate support mast, which can be 1 1/2 inch to 2 inch steel pipe. The support mast is not supplied.

MODEL	AFM-4DA	AFM-24DA	AFM-44DA
Frequency, MHz	144-148	220-225	435-450
2:1 SWR Bandwidth, MHz	>10	>15	>20
Power Rating, Watts	1000	1000	1000
Overall Height, ft	23	15	8
(m)	(7.0)	(4.5)	(2.4)
Wind Area, ft^2	2.58	1.85	1.13
(m^2)	(.24)	(.17)	(.11)
Max Mast OD,in	2	2	2
(cm)	(5.1)	(5.1)	(5.1)

Support Mast Not Included.

THE RINGO RANGER
A Fantastic Two Meter Antenna

The Ringo Ranger should be your antenna where good gain is required, but space does not allow extra height and decoupling radials.
Gain 4.5 dBd, Frequency range 137-160 MHz, Bandwidth 2:1 SWR, >6 MHz, Length 112 in (2.8m), Wind area .33 ft^2 (.03 m^2), Max mast OD 1.25 in (3.2 cm), Weight 4 lbs (1.8 kg), Power handling 1000 watts. Model No. ARX-2.

4-6-7-11 ELEMENT FM YAGIS

Cushcraft FM Yagis are specifically cut for FM amateur frequencies and vertical polarization. Our four and six element models have end brackets for tower or mast side mounting. They feature Reddi Match driven elements with direct 50 ohm feed, compact size, good gain, and front-to-back ratio. And you can count on quick and easy assembly.

YAGI SPECIFICATIONS

MODEL	A147-4	A220-7	A449-6	A449-11
Frequency, MHz	145.5-148	220-225	440-450	440-450
2:1 SWR Bandwidth, MHz	>4	>5	>10	>10
Gain, dBd	10.0	11.0	10.5	13.2
F/B Ratio, dB	18	20	18	20
3-dB Beamwidth, deg	66	57	60	48
Boom Length, in	44	69	35	60
(m)	(1.1)	(1.7)	(.89)	(1.5)
Longest Element, in	40	27	13	13
(m)	(1.0)	(.66)	(.33)	(.33)
Turning Radius, in	44	69	18	60
(m)	(1.1)	(1.7)	(.46)	(1.5)
Wind Area, ft^2	.43	.48	.30	.39
(m^2)	(.04)	(.04)	(.03)	(.04)
Max Mast OD, in	2	2	2	1.50
(cm)	(5.0)	(5.0)	(5.0)	(3.8)
Weight, lb	3	2	3	4
(kg)	(1.4)	(.9)	(1.4)	(1.8)

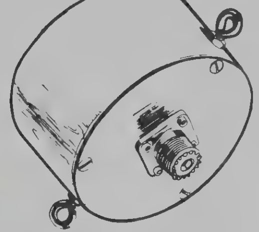
YAGI STACKING KITS

For vertical polarization of two Yagis VPK models are complete with mounting boom harness and hardware.

Antenna	**Frequency MHz**	**Complete Kit**	**Harness Only**
A147-4	144.5-148	A14-VPK	A14-SK
A147-11	144.5-148	A147-VPK	A147-SK
A220-7	220-225	—	A21-SK
A449-6	440-450	—	A449-SK
A449-11	440-450	A449-VPK	A449-SK

A147-20T THE FM/SSB CROSS YAGI

The answer for multi-mode transceivers, ten vertically-polarized elements for 11.1 dBd gain on FM (145-148 MHz), and ten horizontally polarized elements for 11.1 dBd gain for SSB and CW operation (144-146 MHz). Boom length, 130 in. (3.3m); longest element, 40 in. (1.0m); wind area 1.42 ft.^{2} (.13m^2); mast size 1 1/2 in. (38mm)

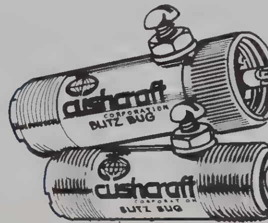


BROADBAND BALUN

Looking for a broadband Balun? Then give serious thought to the new CUSHCRAFT AFB2. This Balun can be used on 160 through 10 meters, including the new WARC frequencies.

It's the perfect answer for wire antennas, and because it's capsulated in an ABS shell, the AFB2 Balun is effectively sealed from moisture and weather.

The AFB2 is manufactured with a low loss ferrite toroid and teflon dielectric coax. It's SO-239 fitting accepts a PL-259 connector. AFB2.

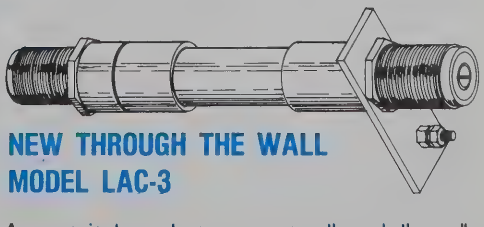


BLITZ BUG LIGHTNING ARRESTERS

For a top performing in-line coaxial lightning arrester, we recommend the BLITZ BUG. The Blitz Bug's three point static discharge ring is protected by U.S. Patent 2,922, 913. Other features: a sealed air chamber, constant static drain, and controlled voltage discharge. The Blitz Bug is rated at 2 KW PEP to 500 MHz with negligible insertion loss.

MODEL LAC-1 with UHF fittings to accept one PL-259 and one SO-239.

MODEL LAC-2 with UHF fittings to accept two PL-259 connectors.



NEW THROUGH THE WALL MODEL LAC-3

A convenient way to run your coax through the wall, including lightning protection. Wall thickness 3 to 5 inches, takes two PL-259 connectors.

RE: No Radials Compact Vertical for 20, 15, and 10 meters.

DEVELOPMENT OBJECTIVES:

A. Operates on 20, 15, and 10 meters
B. SWR less than 1.25 to 1 across design frequency range
C. Requires 1 sq. ft. (.09 sq m) or less of installation area
D. Minimum gain 3 dB over ¼ wave vertical
E. DC grounded for lightning protection
F. Easily assembled, transported, and stored
G. Handle maximum legal power
H. Maintenance free
I. For apartments, condominiums and small spaces

RESULTS:

Please find enclosed data on our new product which we have designated R3. It meets or exceeds all of the development objectives that you outlined.

R3 Engineering Memo

SYNOPSIS OF PERFORMANCE:

The R3 is an end fed ½λ vertical whose natural characteristics eliminate the need for a ground radial system. In order to give it flat SWR from the low end of 20 to the high end of 10 meters we have included a remote tuner at the base of the antenna. The tuner is controlled from the operating position (Fig. 1). This design results in optimum current distribution (see Fig. 2) for maximum efficiency and low angle of radiation for long distance communications.

The antenna is self supporting and mounts over a simple pipe support. It is very rugged and does not require guying. The radiator includes two very slim traps and has a very clean appearance. (see photo and Fig. 3)

We have tested the R3 in all weather. It has also been tested in many typical installation situations such as in a garden, on a porch, on an RV, on the roof of an apartment building, and even on a boat. It would easily tune up lying on the lab floor. We have successfully tested it at high power levels. The R3's tuner helps to eliminate TVI.

Tuning the antenna from the shack is very easy. The Control Console meter gives an excellent indication of proper settings. Packaging of the R3 has been completed and manufacturing is now producing them.

Figure 1 The basic electrical equivalent of matching circuitry at the base of the R3 antenna.
Figure 2 Shows optimum current distribution.
Figure 3 The basic configuration of the Cushcraft R3 antenna.

ADDENDUM: April 8th

Several hundred R3's have been shipped and based on customer suggestions we are now numbering the control wire terminals and including 75 ft (23m) of control wire in the package, performance reports indicate that our design criteria have been exceeded. Many happy users report fantastic DX performance.

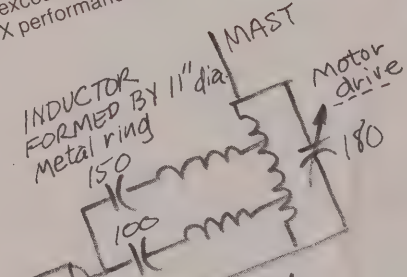


FIG. 1

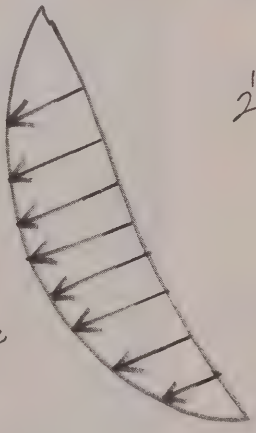


FIG. 2

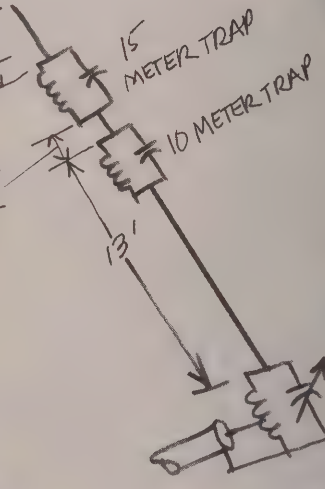


FIG-3

The R3 functions as a completely freestanding antenna on 10/15/20 meters without any radial wires.

A LEADER FOR OVER 30 YEARS

cushcraft
CORPORATION

THE ANTENNA COMPANY
48 Perimeter Road, P.O. Box 4680
Manchester, NH 03108 **USA**
Tel. 603 627-7877 Telex: 953050

ALL CUSHCRAFT ANTENNAS HAVE A 1 YEAR LIMITED WARRANTY.

Specifications subject to change without notice.

20-4CD

15-3CD

R3 HALF WAVE VERTICALS

Just like a finely tuned sports car, high performance can now be yours in a small package. For those long endurance runs the R3 offers full power performance, yet requires only 1 square foot of mounting space without radials. For those conditions requiring agility and quick handling, the R3 offers finger tip remote tuning.

This ½ λ end fed vertical is the perfect choice for the amateur with the limited space of an apartment, condominium, small urban lot or mobile home. It can be set up quickly for operation then stored conveniently out of sight.

The R3 is complete including high Q stabilized traps all hardware and remote control console. R3 is a high performance vertical antenna for worldwide communications.

R3 20-15-10 METERS	
Gain	3 dB
Ground System	None needed
VSWR	1.2:1 or less at every frequency across 20-15-10 meters
Pattern	Omnidirectional
Power	Full 2000 W PEP
Height (ft) (m)	29.9 9.13
Storage Dimensions (ft) (cm)	1 x 1 x 5.50 30.5 x 30.5 x 167.6
Weight (lbs) (kg)	11.5 5.2
Power Required	115V to control box
Control Line Voltage	24 V AC to antenna in tune mode
Termination	50 ohm, S0239
Mast Required (in) (cm)	Permanent mount 1.25 to 1.88 3.2. to 4.8 Temporary mount—None required
Materials (in) (mm)	6063-T832 Seamless aluminum vertical element 1.38 - .63 3.49 - 1.59
Remote Control Box (in) (cm)	6 x 4 x 4 15.2 x 10 x 10
Wind Survival	100 MPH 160.9 KMH
UPS Shippable	

QUARTER WAVE VERTICALS

Cushcraft HF verticals are optimized for wide bandwidth and low angle of radiation necessary to long haul DX communications. They feature our new high Q stabilized trap design rated to 2000 watts PEP. The new larger diameter element tubing is 6063-T832 seamless aluminum. The base mount will take up to a 1⅞" (4.7 cm) O.D. mast with formed clamps for ground radials and/or guy wires. All models may be either roof or ground mounted. A good ground radial system is recommended for maximum performance.

AV3

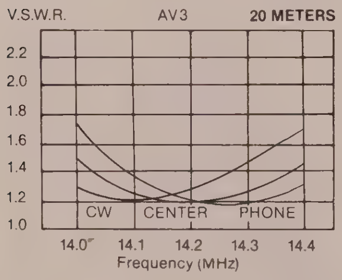
Excellent performance and low height for 20-15-10 meters, only 14 ft., 4.2 m high.

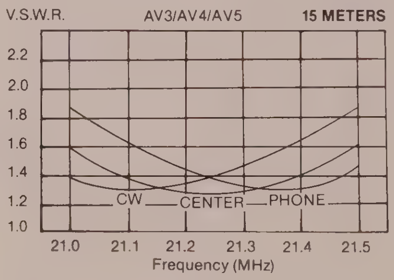
AV4

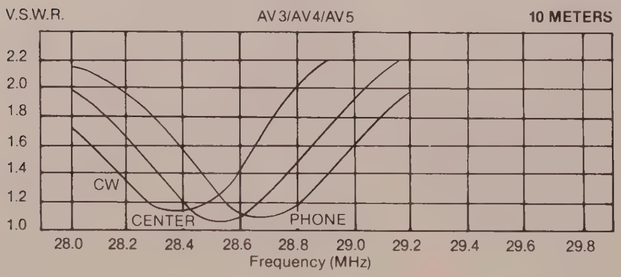
Covers the 40-20-15-10 meter amateur bands with low V.S.W.R. Overall height 19 ft., 5.9 meters.

AV5

Our most popular vertical covers 80-40-20-15-10 meters with excellent bandwidth. The antenna is only 25 ft., 7.4 meters high and it has our new capacitive "X" hat.



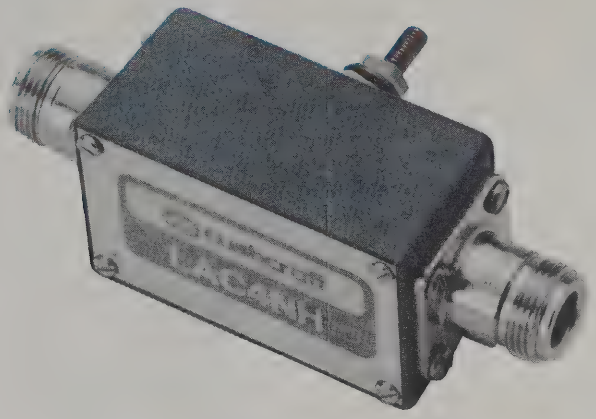




TECHNICAL DATA AND SPECIFICATIONS

cushcraft

LAC-4 SERIES
LIGHTNING ARRESTERS



Cushcraft LAC-4 Lightning Arresters

The Cushcraft LAC-4 series of lightning arresters are designed to protect radio equipment from static electricity and lightning induced surges that travel on coaxial transmission lines. The LAC-4 protects your equipment from surges up to 5,000 Amperes.

The Cushcraft LAC-4 is superior to other available devices because it presents a constant impedance to your transmission line. Mechanically the LAC-4 has been designed to last. All of the mechanical connections in the LAC-4 are positively secured. The gas discharge tube is easily changed by the user if necessary. Our lightning arresters feature a straight forward design. Check our documentation. We are more thorough in telling you what to expect of your LAC-4. The LAC-4 is packaged in an attractively styled diecast box. We have paid particular attention to the details of the fit and finish. The LAC-4 is another example of Cushcraft's committment to supplying quality performance products for radio applications.

THEORY OF OPERATION:

The LAC-4 is a gas discharge tube positioned on a short piece of 50 Ohm transmission line. This gas discharge tube nearly instantaneously changes from an open circuit to a short circuit in the presence of voltage and energy surges, thus providing a path for the surge to follow to ground. The LAC-4 is designed to provide a short circuit path to ground for any fast rise time pulse. It will normally protect sensitive communications equipment from damage. Failure of semiconductor devices is either energy or voltage related, depending upon the semiconductor family. P-N junction type devices (silicon transistors for example) have energy related failure modes. Other devices such as insulated gate FETs or MOS devices will suffer primarily voltage related failures.

The LAC-4 easily prevents energy related failures by the shunting effect of the device. Surge voltages are clamped (ie, limited) to less than 50 volts in about 100 nanoseconds. A typical lightning surge has a voltage rise time of around 2 microseconds. The accepted IEEE standard for testing transient suppressors is an 8 microsecond rise time. Clearly little voltage will be allowed through by the LAC-4.

Some voltage related semiconductor failures can occur even with a properly operating LAC-4. Insulated gate FETs are a prime example. Normally equipment using IGFETS include circuitry to protect these devices. Diodes and filters can provide a measure of protection for such fragile semiconductors. In any event, the LAC-4 will provide the main energy shunt to ground due to its very high current carrying capacity. Many costly repairs can be avoided by installing an LAC-4 in your feedline. With today's sensitive radio equipment, this type of protection has become a requirement.

AVAILABLE MODELS:

The LAC-4 series includes four models —

Model	Connector Type	Maximum Power	Impedance
LAC-4	UHF Female	200 Watts	50 Ohms
LAC-4H	UHF Female	2000 Watts	50 Ohms
LAC-4N	N-Female	200 Watts	50 Ohms
LAC-4NH	N-Female	2000 Watts	50 Ohms

TYPICAL APPLICATIONS

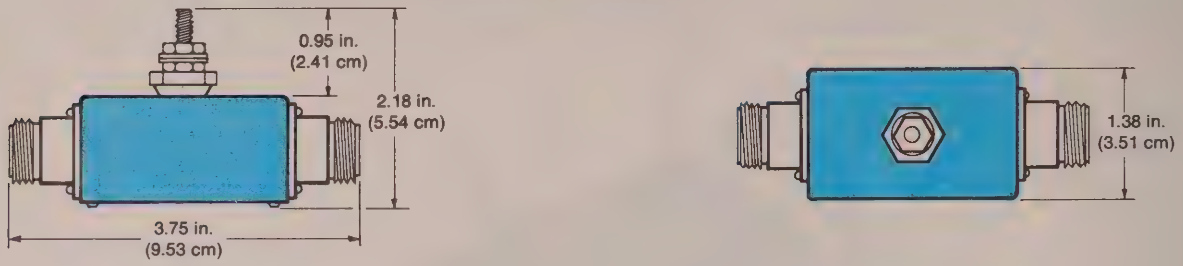
- **Repeaters**
- **Remote Telemetry Transmitters**
- **Long Range Wireless Alarms**
- **Tower Mounted RF Equipment**
- **Amateur Radio Stations**
- **SWL Receivers**

And Other Communications Equipment

INSTALLATION:

It is best to mount the LAC-4 as close to earth ground as possible. It should be mounted either indoors or inside a protected area. The most common installation is just inside the wall where the coaxial cable enters the building. This location is the best since the ground connection lead can be made the shortest length. It is good practice to attach the discharge terminal directly to ground. Sharp bends or loops in the ground wire should be avoided. Appropriate conductors such as #10 solid copper, bronze, or copper clad steel should be selected as the ground wire. (See National Electrical Codes). The dimensions of the LAC-4N are illustrated.

LAC-4 DIMENSIONS



LIFE EXPECTANCY AND FAILURE MODE:

The life of the gas discharge tube depends upon how often it is required to protect your equipment. Very large and frequent surges will reduce its life. Infrequent or small surges will have very little effect on the gas discharge tube. The LAC-4 may deteriorate as the gas tube is exercised. Deterioration may be detected while transmitting as either high VSWR or a warm discharge tube. Deterioration is not apparent when receiving until the unit has failed. When the tube completely fails, it fails shorted, thus giving you the greatest protection. Replacement of the gas discharge tube is a simple matter of replacing the cartridge which is available as a separate item.

SENSITIVITY TO FREQUENCY:

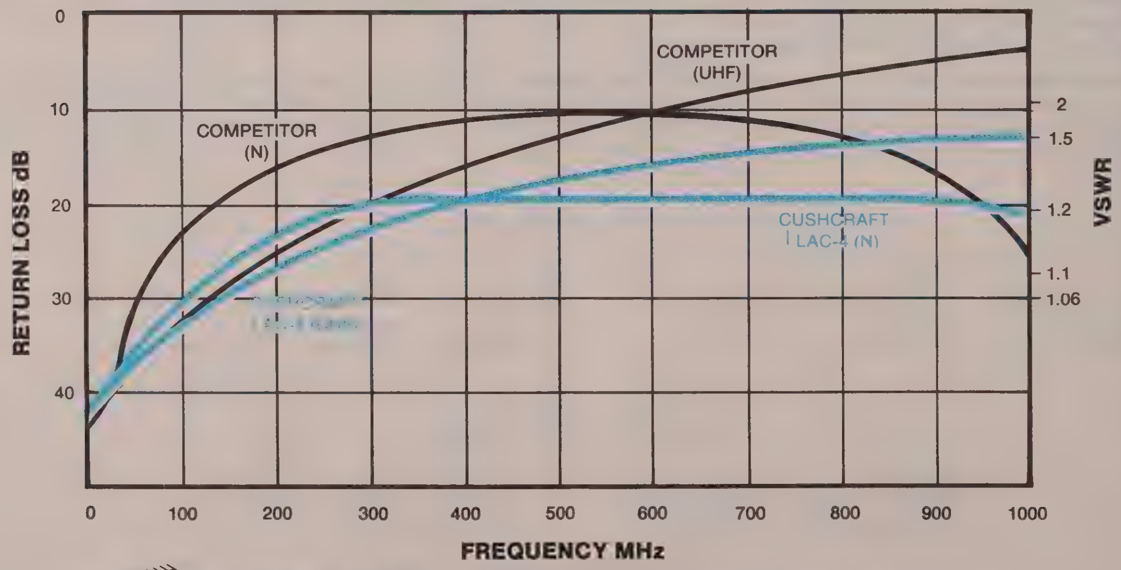
The LAC-4 design and the gas discharge tube are generally not sensitive to frequency. However, the connectors used to attach the LAC-4 to your transmission line are frequency sensitive. Table 1 shows the performance of the LAC-4 at VHF/UHF frequencies.

Table 1

Model	Frequency	Max. Power	Insertion Loss
LAC-4	30 MHz	200 W	Less than 0.1 dB
	150	200	Less than 0.1 dB
	500	100	0.25 dB typical
LAC-4H	30	2000	Less than 0.1 dB
	150	500	Less than 0.1 dB
	500	100	0.25 db typical
LAC-4N	30	200	Less than 0.1 dB
	150	200	Less than 0.1 dB
	500	200	Less than 0.1 dB
	1000	150	0.25 dB typical
LAC-4NH	30	2000	Less than 0.1 dB
	150	1000*	Less than 0.1 dB
	500	800*	Less than 0.1 dB
	1000	500*	0.15 dB typical

*Limited by Type-N connector design

RETURN LOSS/VSWR COMPARISON LAC-4 VS. COMPETITORS MODELS



cushcraft CORPORATION

48 PERIMETER ROAD, MANCHESTER, NH 03108 USA
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TECHNICAL DATA AND SPECIFICATIONS

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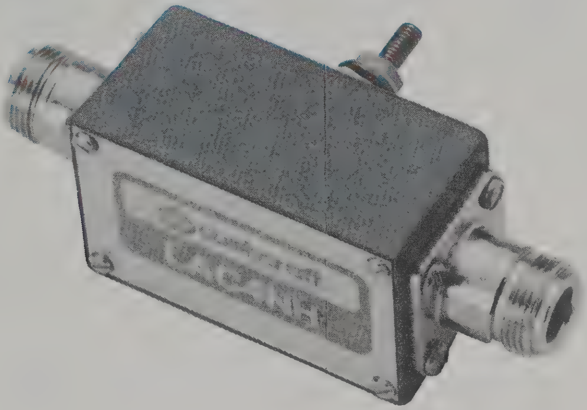
LAC-4 SERIES
LIGHTNING ARRESTERS



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THEORY OF OPERATION:

The LAC-4 is a gas discharge tube positioned on a short piece of 50 Ohm transmission line. This gas discharge tube nearly instantaneously changes from an open circuit to a short circuit in the presence of voltage and energy surges, thus providing a path for the surge to follow to ground. The LAC-4 is designed to provide a short circuit path to ground for any fast rise time pulse. It will normally protect sensitive communications equipment from damage. Failure of semiconductor devices is either energy or voltage related, depending upon the semiconductor family. P-N junction type devices (silicon transistors for example) have energy related failure modes. Other devices such as insulated gate FETs or MOS devices will suffer primarily voltage related failures.

The LAC-4 easily prevents energy related failures by the shunting effect of the device. Surge voltages are clamped (ie, limited) to less than 50 volts in about 100 nanoseconds. A typical lightning surge has a voltage rise time of around 2 microseconds. The accepted IEEE standard for testing transient suppressors is an 8 microsecond rise time. Clearly little voltage will be allowed through by the LAC-4.

Some voltage related semiconductor failures can occur even with a properly operating LAC-4. Insulated gate FETs are a prime example. Normally equipment using IGFETS include circuitry to protect these devices. Diodes and filters can provide a measure of protection for such fragile semiconductors. In any event, the LAC-4 will provide the main energy shunt to ground due to its very high current carrying capacity. Many costly repairs can be avoided by installing an LAC-4 in your feedline. With today's sensitive radio equipment, this type of protection has become a requirement.

AVAILABLE MODELS:

The LAC-4 series includes four models —

Model	Connector Type	Maximum Power	Impedance
LAC-4	UHF Female	200 Watts	50 Ohms
LAC-4H	UHF Female	2000 Watts	50 Ohms
LAC-4N	N-Female	200 Watts	50 Ohms
LAC-4NH	N-Female	2000 Watts	50 Ohms

TYPICAL APPLICATIONS

- Repeaters
- Remote Telemetry Transmitters
- Long Range Wireless Alarms
- Tower Mounted RF Equipment
- Amateur Radio Stations
- SWL Receivers

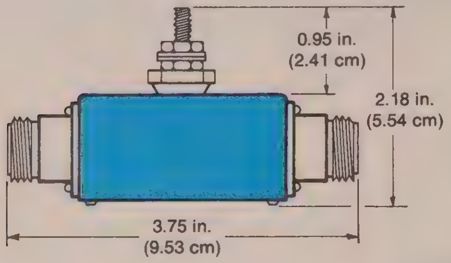
And Other Communications Equipment

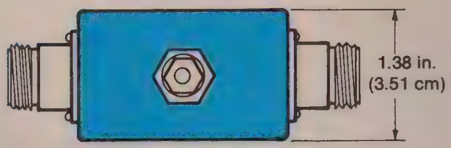
951344 (3/87)

INSTALLATION:

It is best to mount the LAC-4 as close to earth ground as possible. It should be mounted either indoors or inside a protected area. The most common installation is just inside the wall where the coaxial cable enters the building. This location is the best since the ground connection lead can be made the shortest length. It is good practice to attach the discharge terminal directly to ground. Sharp bends or loops in the ground wire should be avoided. Appropriate conductors such as #10 solid copper, bronze, or copper clad steel should be selected as the ground wire. (See National Electrical Codes). The dimensions of the LAC-4N are illustrated.

LAC-4 DIMENSIONS





LIFE EXPECTANCY AND FAILURE MODE:

The life of the gas discharge tube depends upon how often it is required to protect your equipment. Very large and frequent surges will reduce its life. Infrequent or small surges will have very little effect on the gas discharge tube. The LAC-4 may deteriorate as the gas tube is exercised. Deterioration may be detected while transmitting as either high VSWR or a warm discharge tube. Deterioration is not apparent when receiving until the unit has failed. When the tube completely fails, it fails shorted, thus giving you the greatest protection. Replacement of the gas discharge tube is a simple matter of replacing the cartridge which is available as a separate item.

SENSITIVITY TO FREQUENCY:

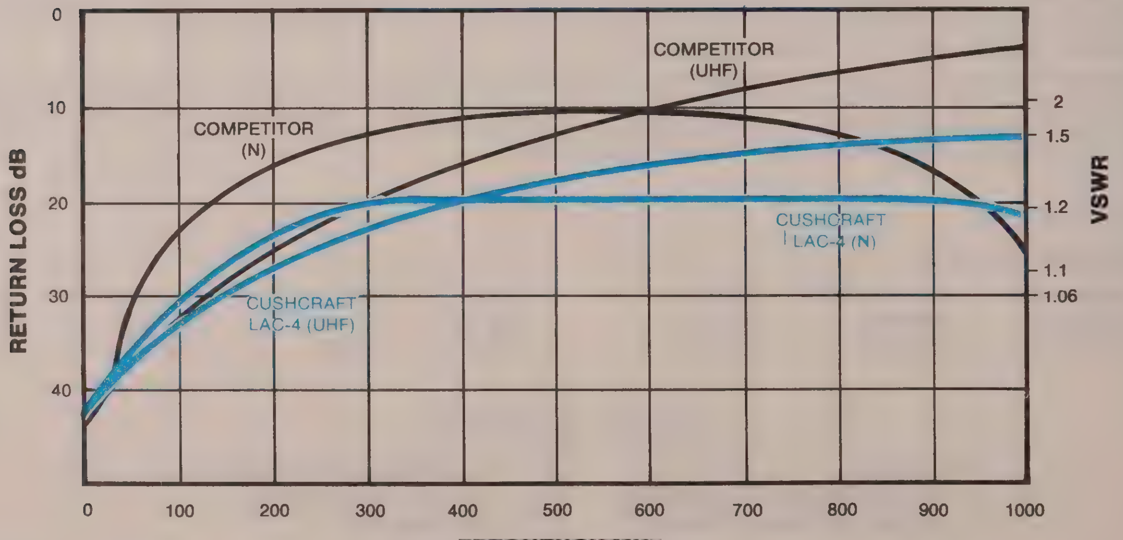
The LAC-4 design and the gas discharge tube are generally not sensitive to frequency. However, the connectors used to attach the LAC-4 to your transmission line are frequency sensitive. Table 1 shows the performance of the LAC-4 at VHF/UHF frequencies.

Table 1

Model	Frequency	Max. Power	Insertion Loss	Model	Frequency	Max. Power	Insertion Loss
LAC-4	30 MHz	200 W	Less than 0.1 dB	LAC-4N	30	200	Less than 0.1 dB
	150	200	Less than 0.1 dB		150	200	Less than 0.1 dB
	500	100	0.25 dB typical		500	200	Less than 0.1 dB
					1000	150	0.25 dB typical
LAC-4H	30	2000	Less than 0.1 dB	LAC-4NH	30	2000	Less than 0.1 dB
	150	500	Less than 0.1 dB		150	1000*	Less than 0.1 dB
	500	100	0.25 db typical		500	800*	Less than 0.1 dB
					1000	500*	0.15 dB typical

*Limited by Type-N connector design

RETURN LOSS/VSWR COMPARISON LAC-4 VS. COMPETITORS MODELS



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603-627-7877 • FAX 603-627-1764 • TELEX 4949472

INSTRUCTIONS AND DATA

HYE-QUE CONNECTORS (HQ-1) AND INSULATORS (HQ-2)

- Increases radiation, superior electrical characteristics.
- Full legal power rating.
- Weather tight, intergal molded construction.
- Rain drip shield surrounds the coax fitting.
- Internal wires, jig bent, large radii, to avoid sharp corners.
- Internal wires mechanical tight and soldered.
- Patent pending.

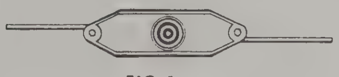


FIG 1

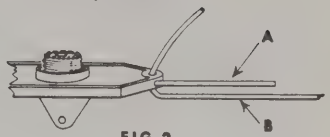


FIG 2

TABLE WL

Frequency	Length
80 meter (3.5 mc)	
3550 kc	66' 3½"
3600 kc	65' 4½"
3650 kc	64' 5½"
3700 kc	63' 6½"
3725 kc	63' 1½"
3750 kc	62' 8½"
3800 kc	61' 10½"
3850 kc	61' 1½"
3900 kc	60' 4½"
3950 kc	59' 7½"
40 meter (7 mc)	
7050 kc	33' 6½"
7100 kc	33' 4"
7175 kc	32' 10½"
7225 kc	32' 9"
7275 kc	32' 6½"
20 meter (14 mc)	
14050 kc	17' ½"
14100 kc	16' 11¾"
14150 kc	16' 11"
14200 kc	16' 10½"
14250 kc	16' 9½"
14300 kc	16' 8½"
14350 kc	16' 8"
15 meter (21 mc)	
21050 kc	11' 6"
21100 kc	11' 5¾"
21150 kc	11' 5¼"
21200 kc	11' 5"
21250 kc	11' 4¾"
21300 kc	11' 4¼"
21350 kc	11' 4"
21400 kc	11' 3¾"
21450 kc	11' 3½"
10 meter (28 mc)	
28600 kc	8' 7"
28800 kc	8' 6½"
29000 kc	8' 6"
29200 kc	8' 5½"
29400 kc	8' 5"
29600 kc	8' 4½"

HYE-QUE
Connector Instructions

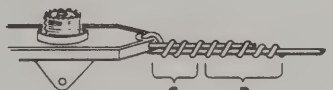


FIG 3

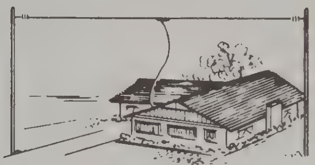


FIG 4

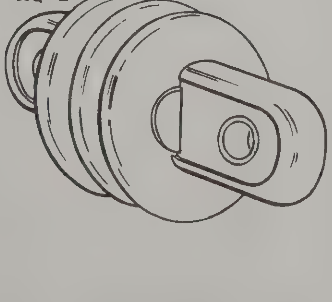
1. Refer to Table WL, select the frequency within the band in which you usually operate. Cut two wires, each to the length indicated. Make a right angle bend exactly three inches from both ends of both wires. If you propose to operate the entire band, cut both wires to the length indicated for the center of the band.
2. Straighten connector wires as shown in Figure 1. They were bent back for packaging.
3. Insert one three inch end of one of the antenna wires into one end hole of the connector as shown in Figure 2, twist this three inch end around wires A and B as shown in Figures 2 and 3.
4. Repeat with the other antenna wire at the opposite end hole of the connector.
5. Hold pliers at C in Figure 3 and solder at D.
6. Attach insulators at the other three inch ends of the antenna wires, solder, using pliers as a heat sink as before.
7. Attach a PL–259 plug to the coax cable, affix the plug to the connector, erect antenna as shown in Figure 4.
8. If desired, the connector may be used to make an "Inverted Vee" antenna. Shorten the wires by 6%, use the top hole in the connector to support the antenna. The low antenna ends should be at least eight feet off the ground.
9. Two or more additional antenna wires, cut for additional bands may also be attached to the connector as previously outlined. These additional antenna wires may be at an angle to the other wires, or droop slightly under them, but they must not touch.
10. In all cases, the coax feeder line must be at least as long as one of the longest antenna wires used. Refer to Table WL.

SPECIFICATIONS

Material: Acrylic Methyl Methacrylate copolymer, 35% glass filled.

Properties	A.S.T.M. test method	
Tensile strength	18,000 psi	D638–D651
Compressive strength	30,000 psi	D695
Flexural strength	34,000 psi	D790
Dielectric strength	500–600	D149
Dielectric constant 60 cycles	2.1	D150
Dielectric constant 10^3 cycles	2.1	D150
Dielectric constant 10^6 cycles	2.1	D150
Dissipation (power) factor 10^6	.0003	D150
Effect of sunlight	NIL	–
Effect of weather	NIL	–
Service life	INDEFINITE	–
Internal capacity	NIL	–

HQ–2



PRICES: POSTPAID
HYE-QUE CONNECTOR $3.95 ea.
HYE-QUE INSULATORS 2 for 99c

BUDWIG MANUFACTURING CO. BOX 97, RAMONA, CALIFORNIA 92065
MANUFACTURERS OF PROPRIETARY PRODUCTS SINCE 1935

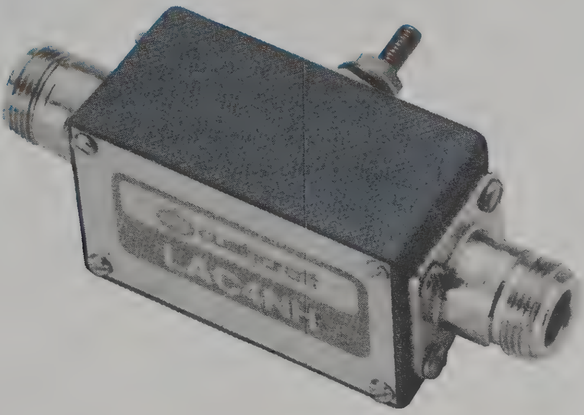
Ham agents wanted for areas outside ham store territories, write for sales information.

FORM 906

TECHNICAL DATA AND SPECIFICATIONS

cushcraft

LAC-4 SERIES
LIGHTNING ARRESTERS



Cushcraft LAC-4 Lightning Arresters

The Cushcraft LAC-4 series of lightning arresters are designed to protect radio equipment from static electricity and lightning induced surges that travel on coaxial transmission lines. The LAC-4 protects your equipment from surges up to 5,000 Amperes.

The Cushcraft LAC-4 is superior to other available devices because it presents a constant impedance to your transmission line. Mechanically the LAC-4 has been designed to last. All of the mechanical connections in the LAC-4 are positively secured. The gas discharge tube is easily changed by the user if necessary. Our lightning arresters feature a straight forward design. Check our documentation. We are more thorough in telling you what to expect of your LAC-4. The LAC-4 is packaged in an attractively styled diecast box. We have paid particular attention to the details of the fit and finish. The LAC-4 is another example of Cushcraft's committment to supplying quality performance products for radio applications.

THEORY OF OPERATION:

The LAC-4 is a gas discharge tube positioned on a short piece of 50 Ohm transmission line. This gas discharge tube nearly instantaneously changes from an open circuit to a short circuit in the presence of voltage and energy surges, thus providing a path for the surge to follow to ground. The LAC-4 is designed to provide a short circuit path to ground for any fast rise time pulse. It will normally protect sensitive communications equipment from damage. Failure of semiconductor devices is either energy or voltage related, depending upon the semiconductor family. P-N junction type devices (silicon transistors for example) have energy related failure modes. Other devices such as insulated gate FETs or MOS devices will suffer primarily voltage related failures.

The LAC-4 easily prevents energy related failures by the shunting effect of the device. Surge voltages are clamped (ie, limited) to less than 50 volts in about 100 nanoseconds. A typical lightning surge has a voltage rise time of around 2 microseconds. The accepted IEEE standard for testing transient suppressors is an 8 microsecond rise time. Clearly little voltage will be allowed through by the LAC-4.

Some voltage related semiconductor failures can occur even with a properly operating LAC-4. Insulated gate FETs are a prime example. Normally equipment using IGFETS include circuitry to protect these devices. Diodes and filters can provide a measure of protection for such fragile semiconductors. In any event, the LAC-4 will provide the main energy shunt to ground due to its very high current carrying capacity. Many costly repairs can be avoided by installing an LAC-4 in your feedline. With today's sensitive radio equipment, this type of protection has become a requirement.

AVAILABLE MODELS:

The LAC-4 series includes four models —

Model	Connector Type	Maximum Power	Impedance
LAC-4	UHF Female	200 Watts	50 Ohms
LAC-4H	UHF Female	2000 Watts	50 Ohms

Model	Connector Type	Maximum Power	Impedance
LAC-4N	N-Female	200 Watts	50 Ohms
LAC-4NH	N-Female	2000 Watts	50 Ohms

TYPICAL APPLICATIONS

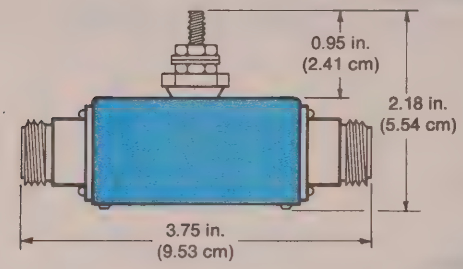
- Repeaters
- Remote Telemetry Transmitters
- Long Range Wireless Alarms
- Tower Mounted RF Equipment
- Amateur Radio Stations
- SWL Receivers

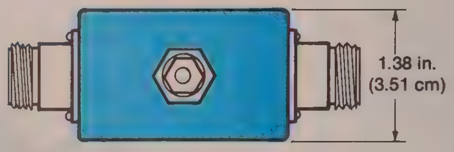
And Other Communications Equipment

INSTALLATION:

It is best to mount the LAC-4 as close to earth ground as possible. It should be mounted either indoors or inside a protected area. The most common installation is just inside the wall where the coaxial cable enters the building. This location is the best since the ground connection lead can be made the shortest length. It is good practice to attach the discharge terminal directly to ground. Sharp bends or loops in the ground wire should be avoided. Appropriate conductors such as #10 solid copper, bronze, or copper clad steel should be selected as the ground wire. (See National Electrical Codes). The dimensions of the LAC-4N are illustrated.

LAC-4 DIMENSIONS





LIFE EXPECTANCY AND FAILURE MODE:

The life of the gas discharge tube depends upon how often it is required to protect your equipment. Very large and frequent surges will reduce its life. Infrequent or small surges will have very little effect on the gas discharge tube. The LAC-4 may deteriorate as the gas tube is exercised. Deterioration may be detected while transmitting as either high VSWR or a warm discharge tube. Deterioration is not apparent when receiving until the unit has failed. When the tube completely fails, it fails shorted, thus giving you the greatest protection. Replacement of the gas discharge tube is a simple matter of replacing the cartridge which is available as a separate item.

SENSITIVITY TO FREQUENCY:

The LAC-4 design and the gas discharge tube are generally not sensitive to frequency. However, the connectors used to attach the LAC-4 to your transmission line are frequency sensitive. Table 1 shows the performance of the LAC-4 at VHF/UHF frequencies.

Table 1

Model	Frequency	Max. Power	Insertion Loss	Model	Frequency	Max. Power	Insertion Loss
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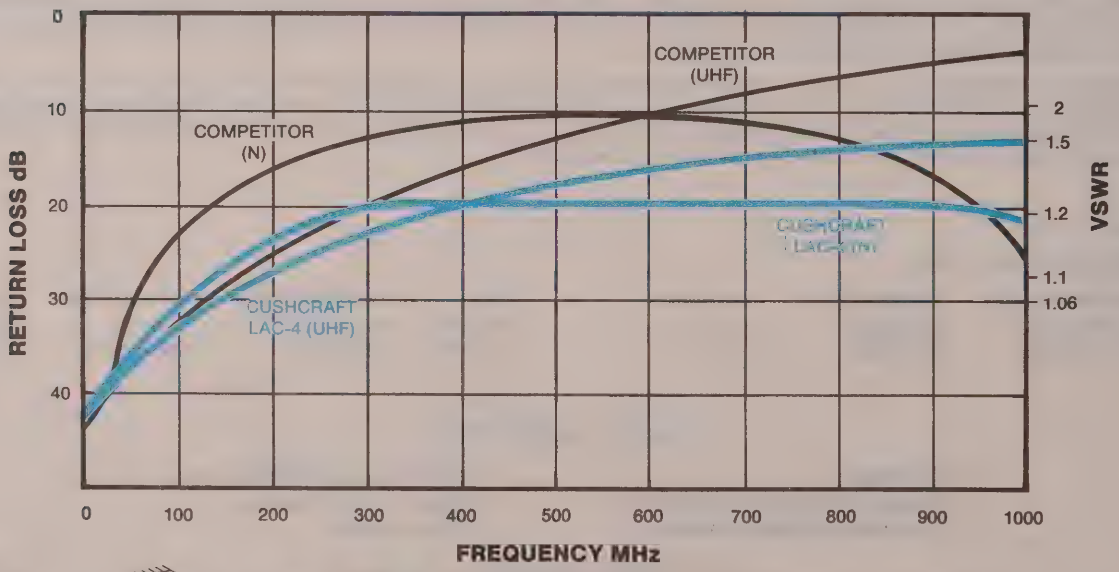
	150	200	Less than 0.1 dB		150	200	Less than 0.1 dB
	500	100	0.25 dB typical		500	200	Less than 0.1 dB
					1000	150	0.25 dB typical
LAC-4H	30	2000	Less than 0.1 dB	LAC-4NH	30	2000	Less than 0.1 dB
	150	500	Less than 0.1 dB		150	1000*	Less than 0.1 dB
	500	100	0.25 db typical		500	800*	Less than 0.1 dB
					1000	500*	0.15 dB typical

*Limited by Type-N connector design

RETURN LOSS/VSWR
COMPARISON
LAC-4 VS. COMPETITORS MODELS



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CORPORATION

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ASSEMBLY AND INSTALLATION

AR-270

DUAL BAND RINGO
70 CM / 2 METER

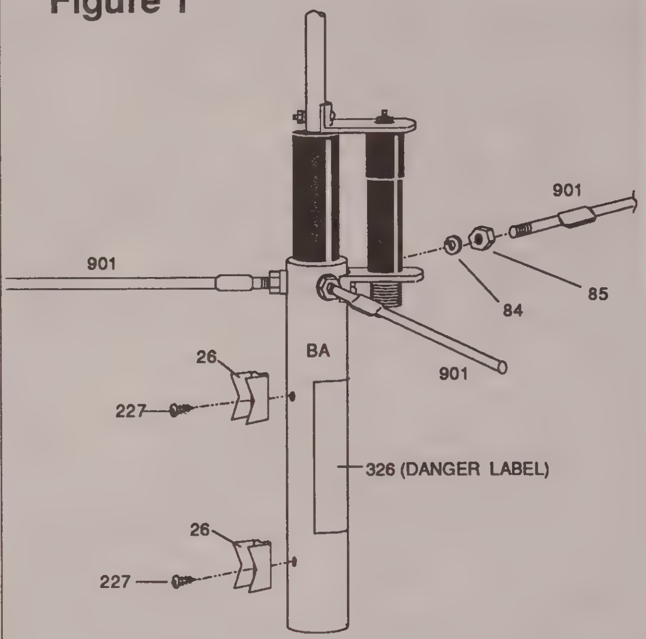
cushcraft
CORPORATION

951375 (10/90)

#1 - ANTENNA ASSEMBLY

Thread the three ground radials (901) into the base section using the washers (84) and nuts (85) provided (figure 1). Insert all three radials (901) an equal amount until they touch each other inside the antenna base assembly (BA). Be very careful not to overtighten the radial rods or their clamping nuts (85). Over tightening may cause permanent unwarranteed damage. Next place the worm clamp (407) on the top of the base section. Then insert the top section of the antenna (TA) to the dimension shown (figure 2) and tighten the clamp. Affix danger label (326) to base (figure 1).

Figure 1

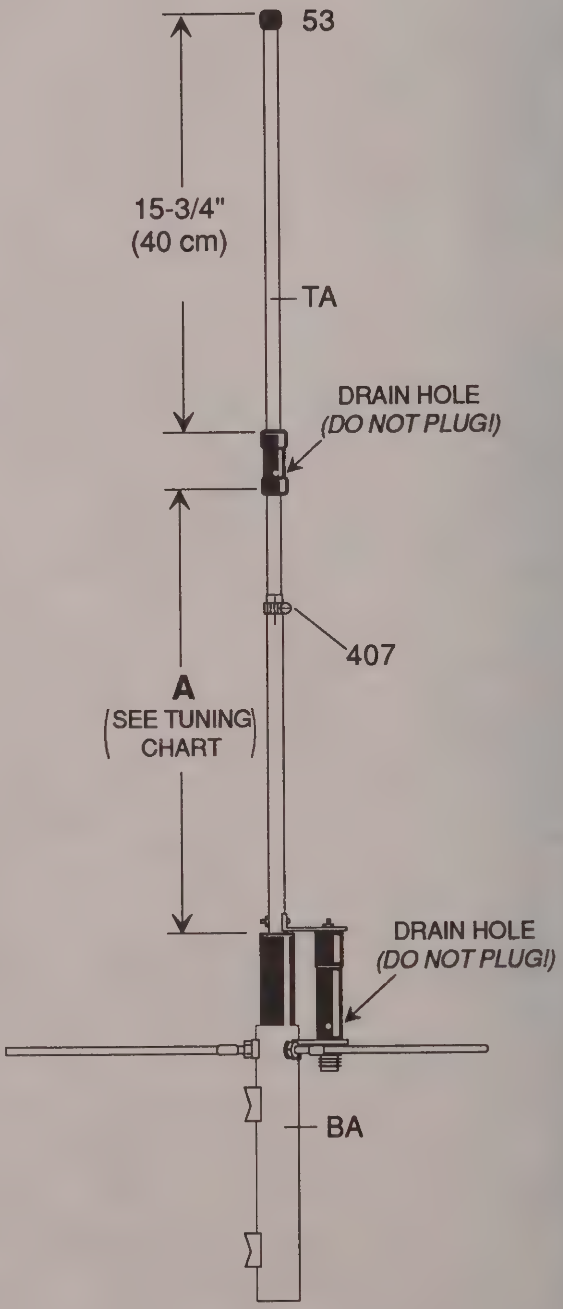


KEY	P/N	DISPLAY	DESC	SIZE	QTY
26	190026		ALUMINUM BRACKET		2
53	050053		PLASTIC CAP	1/2" (1.27 cm)	1
84	010084		LOCK WASHER	1/4" (.6 cm)	3
85	010085		HEX NUT	1/4" (.6 cm)	3
227	010227		SELF TAPPING SCREW	#8 X 1/2" (.95 cm)	2
326	290326		DANGER LABEL		1
407	030407		WORM CLAMP	5/8" (1.6 cm)	1
BA			BASE ASSEMBLY		1
TA			TOP ASSEMBLY		1
901	082901		RADIAL RODS	7" (17.8 cm)	3

TUNING CHART

FREQUENCY RANGE	A
144-146 MHz & 430-440 MHz	17-1/2" (44.45 cm)
145-148 MHz & 438-450 MHz	16-5/8" (42.23 cm)

Figure 2



Your Cushcraft dual band vertical is designed to give top performance and trouble free service. This antenna will perform as specified if the suggestions are followed and care is used in assembly and installation.

LOCATION

Location of the antenna is very important. Surrounding objects such as trees, power lines, other antennas, etc. will seriously reduce efficiency. To minimize the effects of surrounding objects, mount the antenna as high and in the clear as possible. If metal guy wires are used, they should be broken with strain insulators.

Plan your installation carefully. If you use volunteer helpers be sure that they are qualified to assist you. Make certain that everyone involved understands that you are the boss and that they must follow your instructions. If you have any doubts at all, employ a professional antenna installation company to install your antenna.

WARNING: THIS ANTENNA IS AN ELECTRICAL CONDUCTOR. CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THE ANTENNA SHOULD NOT BE LOCATED WHERE PEOPLE OR PETS CAN COME IN CONTACT WITH IT. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION, REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. APPLY THE ELECTRICAL SHOCK WARNING LABEL (326) TO A PROMINENT LOCATION ON THE ANTENNA BASE AS SHOWN ON FIGURE 1. FOLLOW THE GUIDELINES FOR ANTENNA INSTALLATIONS RECOMMENDED BY THE U.S. CONSUMER PRODUCT SAFETY COMMISSION AND LISTED IN THE ENCLOSED PAMPHLET.

MOUNTING

The AR-270 will take up to a 2" (5.1 cm) OD mast. For all installations the antenna must be mounted on the top 6 inches (15 cm) of a mast. It should be mounted above horizontally polarized beam antennas. If you side mount this antenna on a tower it will require a short mast, secured at two points. The mast should be kept at least 1/2 wavelength or 40 inches (100 cm) away from the tower.

SYSTEM GROUNDING

Direct grounding of the antenna, mast and tower is very important. This serves as protection from lightning strikes and static buildup, and from high voltage which is present in the radio equipment connected to the antenna. A good electrical connection should be made to one or more ground rods (or other extensive ground system) directly at the base of the tower or mast, using at least #10AWG ground wire and non-corrosive hardware. For details and safety standards, consult the National Electrical Code. You should also use a coaxial lightning arrester. Cushcraft offers several different models, such as LAC-1, LAC-2 and the LAC-4 series.

ASSEMBLY

Assemble your antenna by following the directions and illustrations in steps #1 through #3. After the antenna is completely assembled, verify the dimensions for accuracy. Return to the section below for final tuning.

TUNING PROCEDURE

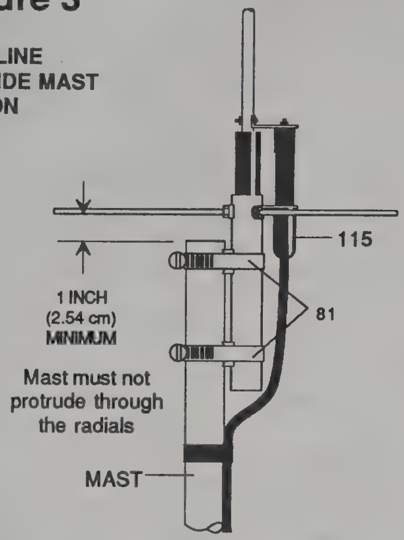
With the dimensions shown in figure 2, the antenna should not require any tuning. If you decide to minimize the VSWR at your favorite operating frequency, insert a good quality 50 Ohm standing wave bridge as close to the antenna as possible. First check the forward power and then the reverse power. Keep away from the antenna when making these tests.

If the VSWR is higher than desired, loosen clamp #407 on the lower section and increase or decrease the length of dimension "A" by 1/4" (.64 cm). If the VSWR increases, reverse direction. If the VSWR decreased, continue in this direction until there is little or no reflected power at the bridge. Remember that both frequency bands will be affected by this adjustment so some compromise may be required.

A VSWR of 1.5:1 meets commercial standards. Even if the VSWR is less then 2:1 this antenna will still radiate an optimum signal and meet all specifications.

Figure 3

FEEDLINE OUTSIDE MAST OPTION



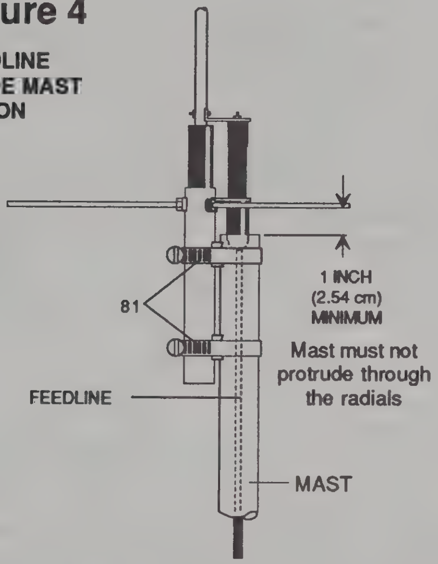
#2 - MASTING

The antenna can be attached to the mast so that the feedline will run down the outside of the mast (figure 3) or down the center of the mast (figure 4). Bracket mounting holes have been drilled on two sides of the base to allow for this option. To run the feedline on the outside of the mast, mount the aluminum brackets (26) with the self tapping screws (227) to the base on the side opposite the connector (figure 1). To run the feedline down the center of the mast, mount the aluminum brackets (26) with the self tapping screws (227) to the base on the same side as the connector.

Attach the antenna to the mast with the worm clamps (81) provided.

Figure 4

FEEDLINE INSIDE MAST OPTION



KEY	P/N	DISPLAY	DESC	SIZE	QTY
81	032881		WORM CLAMP	3" (7.6 cm)	2
115	050115		CONNECTOR BOOT		1
116	240116		SILICONE PACKAGE		1

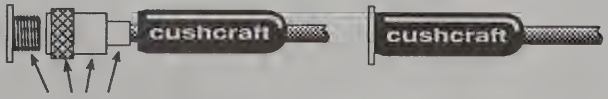
MASTER PARTS LIST

26	190026	Aluminum bracket	2
53	050053	Black plastic cap	1
81	032881	2-1/16-3" worm clamp	2
84	010084	1/4" (.6 cm) lock washer	3
85	010085	1/4" (.6 cm) hex nut	3
115	050115	Connector boot	1
116	240116	Silicone package	1
227	010227	#8 x 1/2" (.95 cm) self tapping screw	2
326	290326	Danger label	1
407	030407	7/32-5/8" worm clamp	1
901	082901	Radial rod	3
BA		Base assembly	1
TA		Top assembly	1

#3 - FEEDLINE

The antenna is designed for use with 50 Ohm coaxial cable terminated with a PL-259 connector. Any length of feedline can be used with your AR-270. The shortest length of cable will have the least loss. A connector boot is included for use with your new antenna (figure 5). Slide the boot over the cable before attaching your PL-259. Coat only the outside connector threads and shell with silicone grease. *Do not coat the center pin or receptacle.* After the PL-259 is firmly screwed on to the antenna connector, slide the vinyl boot over the connector and against the connector bracket for a good weather tight connection. If the antenna has been mounted according to figure 3, tape the feedline to the mast. If you plan to install the antenna in a salty or corrosive environment, you may want to consider coating it with a clear marine varnish or equivalent, after it is assembled.

Figure 5



COAT WITH SILICONE GREASE.
DO NOT coat the center pin or socket!

SPECIFICATIONS

Model	**AR-270**	
Frequency, MHz	144-148	435-450
VSWR 1.2:1 Typical		
2:1 Bandwidth in MHz	>4	>15
Gain, dB	3.7	5.5
Power Rating, Watts FM	250	250
Horizontal Radiation Pattern, Degrees	360	360
Height, ft (m)	3.75 (1.13)	
Mast Size Range, in (cm)	1.25-2.0 (3.2-5.1)	
Radial Length, in (cm)	6.75 (17.1)	
Wind Load, ft^2 (m^2)	0.27 (0.03)	
Weight, lb (kg)	2.0 (0.9)	

LIMITED WARRANTY

Cushcraft Corporation, P.O. Box 4680, Manchester, New Hampshire 03108, warrants to the original consumer purchaser for one year from date of purchase that each Cushcraft antenna is free of defects in material or workmanship. If, in the judgement of Cushcraft, any such antenna is defective, then Cushcraft Corporation will, at its option, repair or replace the antenna at its expense within thirty days of the date the antenna is returned (at purchasers expense) to Cushcraft or one of its authorized representatives. This warranty is in lieu of all other expressed warranties, any implied warranty is limited in duration to one year. Cushcraft Corporation shall not be liable for any incidental or consequential damages which may result from a defect. Some states do not allow limitations on how long an implied warranty lasts or exclusions or limitations of incidental or consequential damages, so the above limitation and exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. This warranty does not extend to any products which have been subject to misuse, neglect, accident or improper installation. Any repairs or alterations outside of the Cushcraft factory will nullify this warranty.

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THE ANTENNA COMPANY

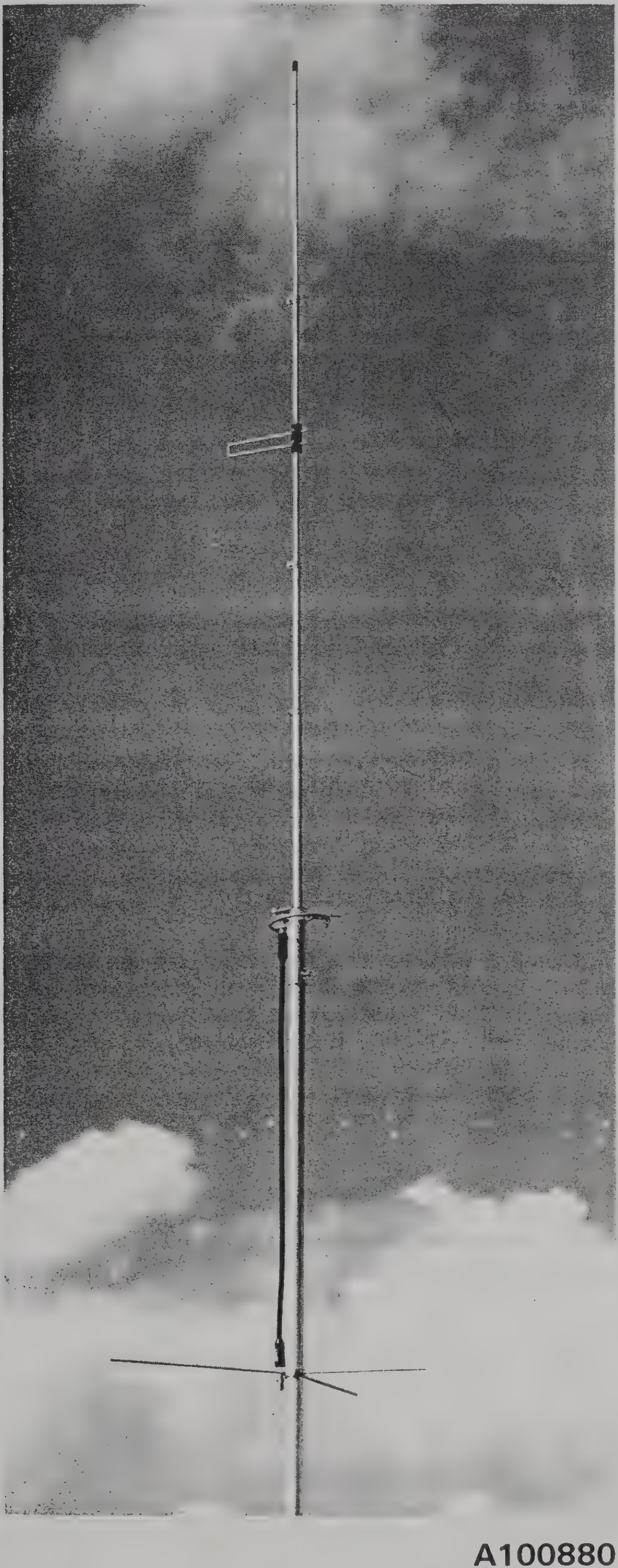
48 PERIMETER ROAD, MANCHESTER, NH 03108 USA
603-627-7877 • TELEX: 4949472 • FAX: 603-627-1764

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

ASSEMBLY AND INSTALLATION INSTRUCTIONS

ARX-2B,
ARX-220B,
and ARX-450B

Ringo Ranger II
Antenna



cushcraft
CORPORATION

A100880

Your Cushcraft Ringo Ranger II is designed and manufactured to give top performance and trouble free service. The antenna will perform as specified if the instructions and suggestions are followed and care is used in assembly and installation.

Masting

The ARX-2B and ARX-220B will take up to a 1⅜" (3.5 cm) OD mast. For most installations a 1¼" (3.2 cm) OD TV type mast will be satisfactory. The ARX-450B will take up to a 1" (2.5 cm) OD mast. A total of 55" (139.7 cm) of exposed mast is necessary to install the ARX-2B. The ARX-220B requires 38" (91.4 cm) and the ARX-450B needs 20" (50.8 cm).

Location

Location of the antenna is very important. Surrounding objects such as trees, power lines, other antennas, etc. will seriously reduce efficiency. To minimize the effects of surrounding objects, mount the antenna as high and in the clear as possible. If metal guy wires are used, they should be broken with strain insulators. WARNING: THIS ANTENNA IS AN ELECTRICAL CONDUCTOR, CONTACT WITH POWER LINES CAN RESULT IN DEATH, OR SERIOUS INJURY. DO NOT INSTALL THIS ANTENNA WHERE THERE IS ANY POSSIBILITY OF CONTACT WITH OR HIGH VOLTAGE ARC-OVER FROM POWER CABLES OR SERVICE DROPS TO BUILDINGS. THE ANTENNA, SUPPORTING MAST AND/OR TOWER MUST NOT BE CLOSE TO ANY POWER LINES DURING INSTALLATION REMOVAL OR IN THE EVENT PART OF THE SYSTEM SHOULD ACCIDENTALLY FALL. FOLLOW THE GUIDELINES FOR ANTENNA INSTALLATIONS RECOMMENDED BY THE U.S. CONSUMER PRODUCT SAFETY COMMISSION AND LISTED IN THE ENCLOSED PAMPHLET.

Mounting

Several antennas may be mounted on the same mast. Your Ringo Ranger II may be mounted on the top of a beam antenna. When side mounting your Ringo Ranger II on a tower, it should be kept at least ¼ wavelength out from the tower.

Antenna Assembly

Attach the matching ring as shown in figure 2. Assemble the tuning rod clamp, place it over the tuning ring and slide the tuning rod through it. Attach the flattened end of the coax connector. Be sure the tuning rod is on the proper side of the base.

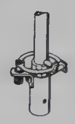
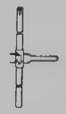
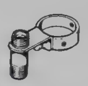
Using figure 1 assemble the radiating section. Adjust dimensions A, B, and C using chart A. Tighten all fasteners snugly.

Assemble the radial ring as shown in figure 3. Then slide it into position, attach the coaxial line between the matching ring and the radial ring. Coat the outside of the aluminum connector threads and the PL-259 with silicone grease provided. Do not coat the connector center pin and socket with silicone. Slide the vinyl boots over the connectors and against the plate for a good weather-tight connection. Follow the same procedure for your 50 ohm coaxial feed cable and be sure to slide the vinyl boot over the cable before attaching the PL-259 connector. Tighten the radials snugly and evenly to the mast. DO NOT OVER TIGHTEN. Over tightening may cause perminent unwarranteed damage. (See Steps 1 and 2.)

Tuning

Mount the antenna clear of surrounding objects. Keep all metal obstructions such as guy wires and other antennas at least 25 feet away. Attach a good quality VSWR bridge in the coaxial cable as close to the antenna as possible and note the VSWR at your frequency. For the ARX-2B and ARX-220B move the tuning rod for lowest VSWR. For the ARX-450B adjust the length of the lower section for minimum VSWR.

PARTS LIST ARX-450B

	DISPLAY	DESC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY w/ RING		1
LL		PHASING STUB ASSEMBLY	3/8" x 28 3/4" (0.9 x 73.0 cm)	1
KK		RADIAL RING ASSEMBLY		1
JJ		ALUM. RADIAL ROD	1/4" x 6 3/4" (0.64 x 17.1 cm)	3
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	17" (43.1 cm)	1

PARTS PACKAGE ARX-2B, ARX-220B

P/N	DETAIL	DESC.	SIZE	QTY.
9		MACHINE SCREW	8-32 x 5/8" (1.6 cm)	2
10		INTERNAL TOOTH WASHER	#8	3
11		HEX NUT	#8-32	4
81		MACHINE SCREW	1/4" - 20 x 3/4 (1.9 cm)	1
67		TUNING ROD CLAMP		1
77		PLASTIC CAP	3/8" (0.9 cm)	1
94		LOCK NUT	1/4" - 20 (.64 cm)	1
96		MACHINE SCREW	#8-32 x 3/8" (0.9 cm)	2
97		FORMED TUNING ROD	3/16" x 5" (0.48 x 12.7 cm	1
G-6		TELESCOPE CLAMP	1/2" (1.3 cm)	1
G-7		TELESCOPE CLAMP	5/8" (1.6 cm)	1
G-8		TELESCOPE CLAMP	3/4" (1.91 cm)	1
85		HEX NUT	1/4" - 20 (0.64 cm)	3
84		LOCK WASHER	1/4" (0.64 cm)	3

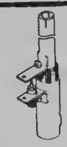
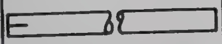
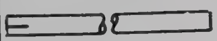
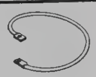
PARTS PACKAGE ARX-450B

P/N	DISPLAY	DESC.	SIZE	QTY.
85		HEX NUT	1/4" - 20 (0.64 cm)	3
84		LOCK WASHER	1/4" (0.64 cm)	3
155		LOCKING RING		1
80		MACHINE SCREW	8-32 x 1/2" (1.6 cm)	1
11		8-32 HEX NUT		
GS-4 SS		WORM CLAMP		

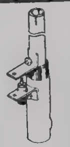
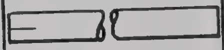
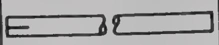
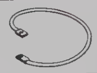
CHART A

Freq. MHz	Dimension A	Dimension B	Dimension C
ARX-2B			
135	59 1/2″ (1.51 m)	54 1/2″ (1.38 m)	9 3/4″ (24.8 cm)
137	58 3/4″ (1.49 m)	53 3/4″ (1.36 m)	9 1/2″ (24.1 cm)
140	57 1/2″ (1.46 m)	52 1/2″ (1.33 m)	9 1/4″ (23.5 cm)
142	56 3/4″ (1.44 m)	51 3/4″ (1.31 m)	9 1/8″ (23.2 cm)
145	55 1/2″ (1.41 m)	50 1/2″ (1.28 m)	9″ (22.9 cm)
146	55 1/8″ (1.40 m)	50 1/8″ (1.27 m)	8 9/16″ (22.7 cm)
147	54 3/4″ (1.39 m)	49 3/4″ (1.26 m)	8 7/8″ (22.5 cm)
150	53 1/2″ (1.36 m)	48 3/4″ (1.24 m)	8 3/4″ (22.2 cm)
152	52 3/4″ (1.34 m)	48″ (1.22 m)	8 5/8″ (21.9 cm)
155	51 3/4″ (1.31 m)	47″ (1.19 m)	8 1/2″ (21.6 cm)
157	51″ (1.29 m)	46 1/4″ (1.17 m)	8 3/8″ (21.3 cm)
160	50″ (1.27 m)	45 1/2″ (1.16 m)	8 1/4″ (21.0 cm)
ARX-220B			
220-225	33 1/8″ (84.1 cm)	32″ (81.3 cm)	5 3/4″ (14.6 cm)
ARX-450B			
435-450	17″ (43.2 cm)	NONE	3″ (7.6 cm)
450-470	16 1/2″ (41.9 cm)	NONE	2 7/8″ (7.3 cm)

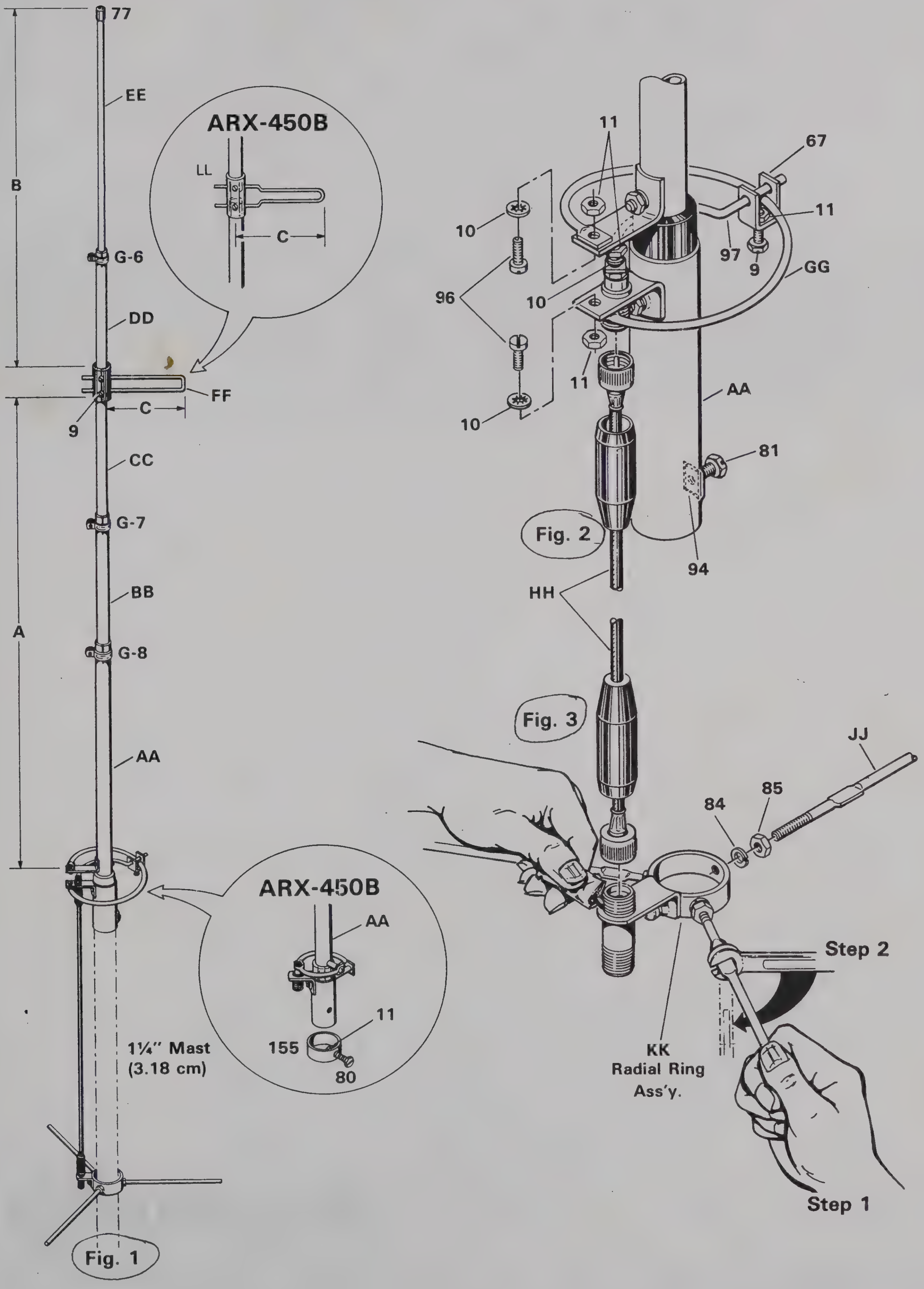
PARTS LIST ARX-2B

P/N	DISPLAY	DISC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY		1
BB		ALUM. TUBING	5/8″ x 15″ (1.6 x 38.1 cm)	1
CC		ALUM. TUBING	1/2″ x 21″ (1.3 x 53.3 cm)	1
DD		ALUM. TUBING w/ INSULATOR	1/2″ x 24″ (1.3 x 70 cm)	1
EE		ALUM. TUBING	3/8″ x 35″ (0.9 x 88.9 cm)	1
FF		ALUM. PHASING STUB	10 1/2″ (26.6 cm)	1
GG		ROD BASE RING	5″ROUND x 1/4″ (12.7 x 0.64 cm)	1
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	50 1/2″ (127.2 cm)	1
JJ		ALUM. RADIAL RODS	1/4″ x 20 1/2″ (0.64 x 52.1 cm)	3
KK		RADIAL RING ASSEMBLY		1

PARTS LIST ARX-220B

P/N	DETAIL	DESC.	SIZE	QTY.
AA		BASE SECTION ASSEMBLY		1
BB		ALUM. TUBING	5/8″ x 15″ (1.59 x 38.1 cm)	1
CC		ALUM. TUBING	1/2″ x 12″ (1.2 x 30.5 cm)	1
DD		ALUM. TUBING w/ INSULATOR	1/2″ x 12″ (1.2 x 30.5 cm)	1
EE		ALUM. TUBING	3/8″ x 24″ (0.9 x 61 cm)	1
FF		ALUM. PHASING STUB	6 3/4″ (17.1 cm)	1
GG		ROD BASE RING	5″ROUND x 1/4″ (12.7 x 0.64 cm)	1
HH		RG8/U COAX CABLE w/ CONN. & BOOTS	33″ (83.8 cm)	1
JJ		ALUM. RADIAL RODS	1/4″ x 13 1/4″ (0.64 x 33.7 cm)	3
KK		RADIAL RING ASSEMBLY		1

ARX-2B, ARX-220B



LIMITED WARRANTY

CUSHCRAFT CORPORATION, P.O. BOX 4680, MANCHESTER, NEW HAMPSHIRE 03108, WARRANTS TO THE ORIGINAL CONSUMER PURCHASER FOR ONE YEAR FROM DATE OF PURCHASE THAT EACH CUSHCRAFT ANTENNA IS FREE OF DEFECTS IN MATERIAL OR WORKMANSHIP. IF, IN THE JUDGEMENT OF CUSHCRAFT, ANY SUCH ANTENNA IS DEFECTIVE, THEN CUSHCRAFT CORPORATION WILL, AT ITS OPTION, REPAIR OR REPLACE THE ANTENNA AT ITS EXPENSE WITHIN THIRTY DAYS OF THE DATE THE ANTENNA IS RETURNED (AT PURCHASER'S EXPENSE) TO CUSHCRAFT OR ONE OF ITS AUTHORIZED REPRESENTATIVES. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESSED WARRANTIES, ANY IMPLIED WARRANTY IS LIMITED IN DURATION TO ONE YEAR. CUSHCRAFT CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM A DEFECT. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR EXCLUSIONS OR LIMITATIONS OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION AND EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. THIS WARRANTY DOES NOT EXTEND TO ANY PRODUCTS WHICH HAVE BEEN SUBJECT TO MISUSE, NEGLECT, ACCIDENT OR IMPROPER INSTALLATION. ANY REPAIRS OR ALTERATIONS OUTSIDE OF THE CUSHCRAFT FACTORY WILL NULIFY THIS WARRANTY.

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SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

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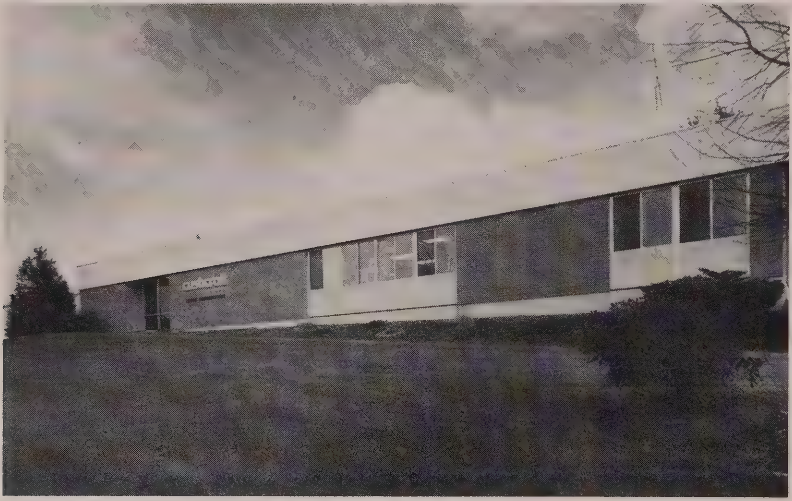
5 NEW PRODUCTS!

R5	NO-GROUND-RADIAL VERTICAL
R45K	18 MHz CONVERSION KIT
TEN-3	10 METER 3 ELEMENT BEAM
D3W	WORLD RANGER DIPOLE
CS28M	10 METER MOBILE

THE ANTENNA COMPANY



Hams around the world have trusted Cushcraft for over 35 years. That's why we are the largest manufacturer of amateur radio antennas!

Whether you are running full power to a distant country or just want to work the local repeater, you will find what you need at Cushcraft. We have the right model for each of your applications.

Our antennas are proven winners! And you can be a winner, too, by selecting a Cushcraft antenna from this catalog.

If you need help in choosing the right model for your site, you dealer has the answers. Call or visit him today.

ANTENNA LOCATOR CHART

DESCRIPTION	POPULAR MODES				BANDS OF OPERATION												
	SSB	CW	FM	PACKET	80	40	30	20	17	15	12	10	6	2	1.25	0.7	
HF TRI-BAND YAGIS	■	■				■		■		■		■					1
HF ADD-ON KTTS	■	■				■	■										2
HF ROTATABLE DIPOLES	■	■				■	■	■	■	■	■	■					2
HF HALF WAVE R5 VERTICAL	■	■						■	■	■	■	■					3
HF QUARTER WAVE VERTICALS	■	■			■	■	■	■	■	■	■	■					4
HF MONOBAND YAGIS	■	■				■		■		■	■	■					5, 6
VHF BOOMER YAGIS	■	■		■										■			7
VHF-UHF BOOMER YAGIS	■	■											■		■	■	8
VHF-UHF FM BOOMER YAGIS	■	■	■	■										■	■		9
HF-VHF-UHF OMNI VERTICALS			■	■								■	■	■	■	■	10,13
HF-VHF-UHF MOBILES/PORTABLES			■	■								■	■	■	■	■	11
VHF-UHF FM YAGIS	■	■	■	■										■	■	■	12, 13
HF-VHF-UHF SIDEBAND YAGIS	■	■										■	■	■	■	■	14
VHF-UHF OSCAR CIRCULAR YAGIS	■	■		■										■		■	15
VHF-UHF ATV -SIDEBAND ARRAYS	■	■												■		■	15
HF-VHF-UHF LIGHTNING ARRESTERS	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	16
VHF-UHF BOOMER STACKING KITS	■	■	■	■									■	■	■	■	16
VHF-UHF MOBILE MOUNTS													■	■	■	■	11
ANTENNA FACTS, TERMINOLOGY																	17

WORLD RANGER

MULTIBAND HF YAGIS 10-15-20-40 METERS

A4S FOUR ELEMENT BEAM

With Stainless Steel Hardware

The A4S is the true high performance tribander. Precisely tuned high-power traps, carefully selected element lengths, and proper spacing combine to make the A4S the preferred antenna for your contest work!

This is the premium antenna with all the features that you want. High gain, low SWR, and wide bandwidth keep the contacts coming in. All U-bolts, clamps and hardware are stainless steel. The A4S has pinned boom sections and formed aluminum brackets to keep elements straight under all conditions. And our solid construction keeps the A4S on the tower!

MODEL	**A4S**
Frequency, MHz	28, 21,14
No. Elements	4
Forward Gain, dBd	8.9
Front to Back Ratio, dB	25
SWR 1.2:1 Typical	
2:1 Bandwidth KHz	>500
Power Rating, Watts PEP	2000
3dB Beam Width, Deg, E Plane	58
Boom Length, ft(m)	18(5.48)
Boom Diameter, in(cm)	2(5.10)
Longest Element, ft(m)	32(9.75)
Element Center Dia, in(cm)	1.13(2.86)
Turning Radius, ft(m)	18.40(5.49)
Mast Size Range,in(cm)	1.25-2.0(3.18-5.08)
Wind Load, ft²(m²)	5.50(0.51)
Weight, lb(kg)	37(16.8)

A3 THREE ELEMENT BEAM

The A3 World Ranger is our top-selling tribander! It's a real power-house in a small space and lets you work the pile-ups with confidence.

All you need is a lightweight tower and a rotator to enjoy the benefits of the A3. It's a proven performer in DX-peditions and contests and handles full-power from your linear. It has pinned boom sections and formed aluminum element brackets.

When space is at a premium, but you want the benefits of a full-size tribander, the A3 is right for you!

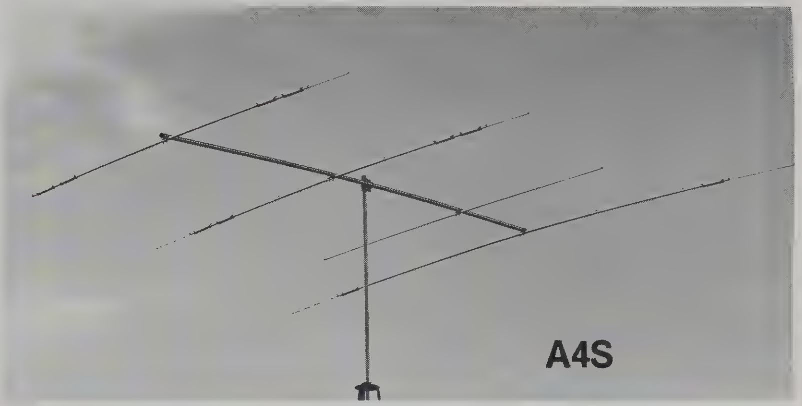
MODEL	**A3**
Frequency, MHz	28, 21,14
No. Elements	3
Forward Gain, dBd	8
Front to Back Ratio, dB	25
SWR 1.2:1 Typical	
2.1 Bandwidth, KHz	>500
Power Rating, Watts PEP	2000
3dB Beam Width, Deg, E Plane	60
Boom Length, ft(m)	14(4.26)
Boom Diameter, in(cm)	1.50(3.81)
Longest Element, ft(m)	27.75(8.45)
Element Center Dia, in(cm)	1.13(2.86)
Turning Radius, ft(m)	15.50(4.72)
Mast Size Range,in(cm)	1.25-2.0(3.18-5.08)
Wind Load, ft²(m²)	4.36(0.47)
Weight, lb(kg)	27(12.9)

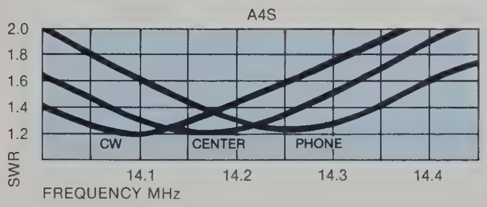
Cushcraft Tribanders Make More DX Fun!

Our three and four element tribanders provide the versatility and performance that you need for reliable communication around the world.

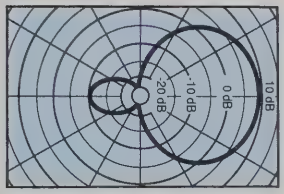
And they last! Cushcraft's World Rangers are made with 6063-T832 aluminum tubing, weatherproof traps, and fiberglass insulators to stand up to the weather. Our World Rangers have 50 ohm twin terminal connectors and need no balun. They are designed with fewer parts for easier assembly, lower weight and less windload. You will spend your time in the shack, not on the tower!

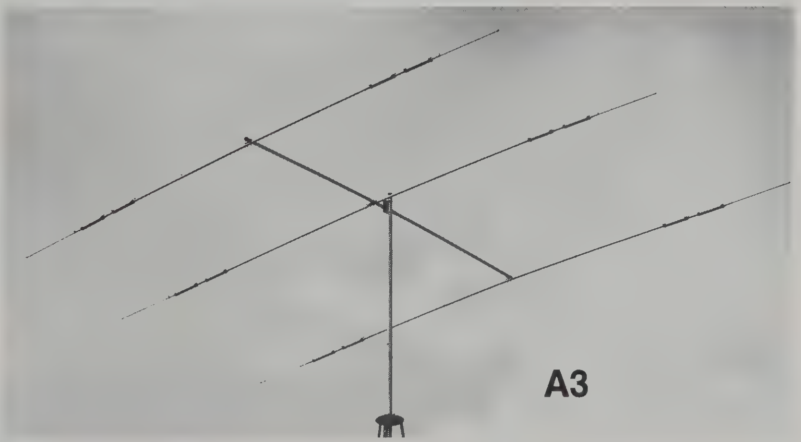
Ham radio is a lot more fun when you have a dependable antenna like our World Ranger. Make your choice from our A4 and A3 models. And add a forty meter kit to make your antenna even more versatile!

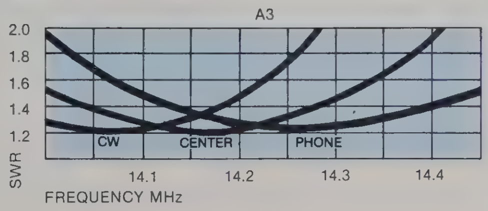




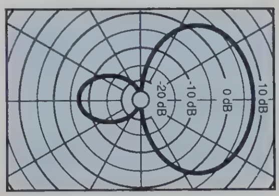
A4S RADIATION PATTERN





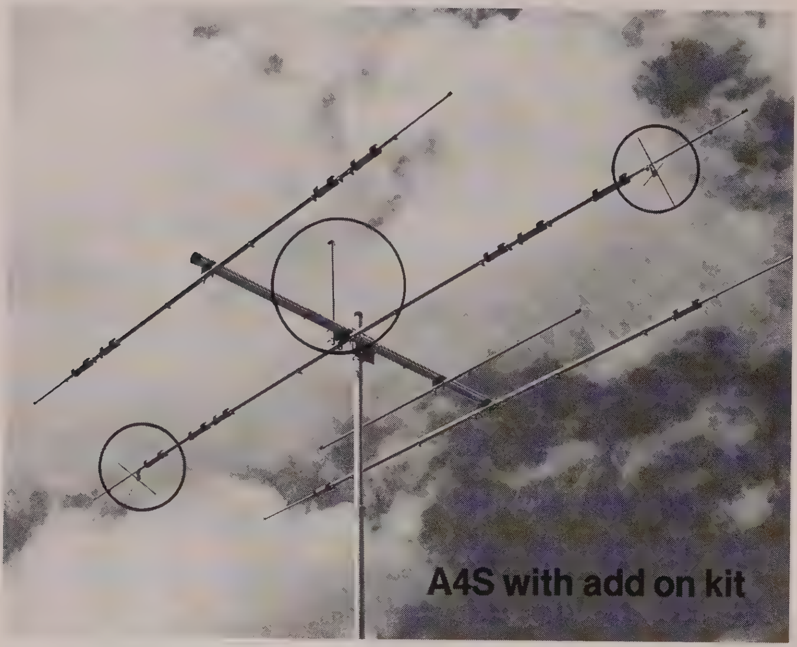


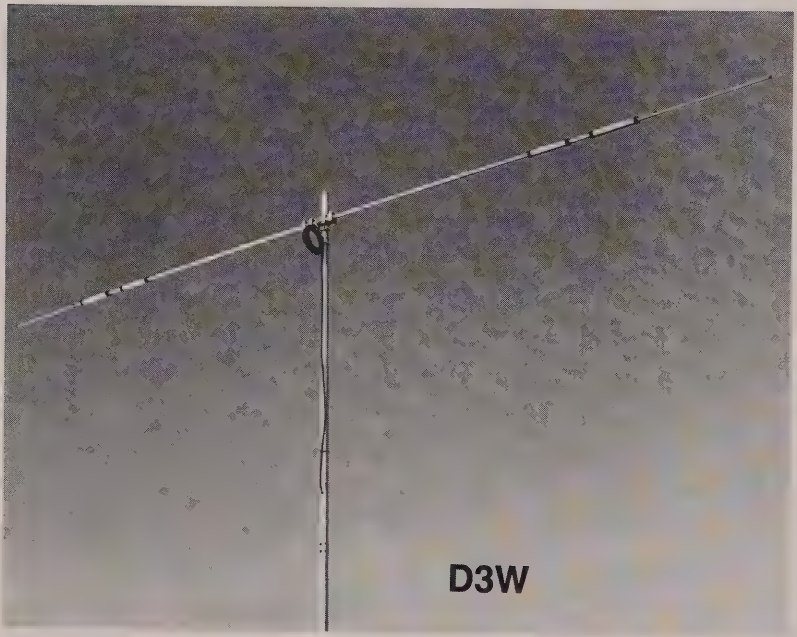
A3 RADIATION PATTERN



MORE WORLD RANGERS

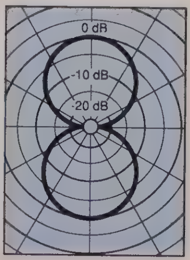
10, 15, 20, 30, 40 METERS





NEW D3W WORLD RANGER DIPOLE

The perfect answer for the WARC bands including our newest 18 MHz. This rotatable dipole is easily mounted on the same mast as you existing tri-bander or other antennas. With a bi-directional pattern it will give you amazing performance on the new bands.



40 METER ADD-ON KITS

If you think that our tribanders are the most versatile antennas on the market, wait til you try our 30/40 meter add-on kit!

This easy-to-install kit includes our high-power traps, a super-strong center insulator, non-stretch support line, and all of the necessary hardware.

In no time at all, you will be working 40 meters on your A4S or A3! Or, with a simple adjustment, the 10 MHz WARC band is at your fingertips!

A743	**7 MHz/10 MHz kit for A3**
A744	**7 MHz/10 MHz kit for A4S**

A743 & A744	**7 MHz (40 m)**	**10 MHz (30 m)**
Driven Element with Adapter kit, ft (m)	33.19 min. 35.33 max. (10.12-10.77)	27.12 min. 28.4 max. (8.27-8.66)
Windloadkng ft^2 (m^2)	.58 (.05)	.27 (.03)
Bandwidth, KHz	125	150
Power Rating, Watts	2000 PEP	2000 PEP
Side Rejection, dB	20	20
Weight, lb (kg)	3.44 (1.56)	2.29 (1.04)

STAINLESS STEEL KIT

You can install your A3 beam with all stainless steel hardware from this kit to reduce potential damage from rust or corrosion caused by salt water or industrial pollutants. The kit includes all necessary clamps and fasteners.

A3SK

ROTATABLE DIPOLES - SINGLE AND MULTIBAND

Our World Ranger Dipoles give bi-directional performance and rotatable convenience. You can mount them high and away from the trees for much better performance than a wire dipole. Our single and multi-band dipoles feature high-performance traps, heavy wall tubing, and rugged hardware for years of enjoyment.

When cost or space prevent you from installing a multi-element rotatable antenna, the World Ranger Dipole is a great choice!

MODEL	**D40**	**D4**	**D3**	**D3W**
Frequency, m	40	10,15,20,40	10,15,20	12,17,30
Bandwidth, SWR 1.2:1 Typical 2:1 Bandwidth, KHz	200	>350 40>125	>500	>200
Power Rating Watts PEP	2000	2000	2000	2000
Length ft	42.25	35.8	25.8	34.0
(m)	(12.88)	(10.92)	(7.86)	(10.37)
Mast Dia. Max., in	2	2	2	2
(cm)	(5)	(5)	(5)	(5)
Wind Load, ft^2	1.3	1.3	.9	.9
(m^2)	(.12)	(.12)	(.08)	(.08)
Weight, lb	12	13	9	11
(kg)	(5)	(6)	(4)	(5)

NEW R5 NO-GROUND-RADIAL VERTICAL

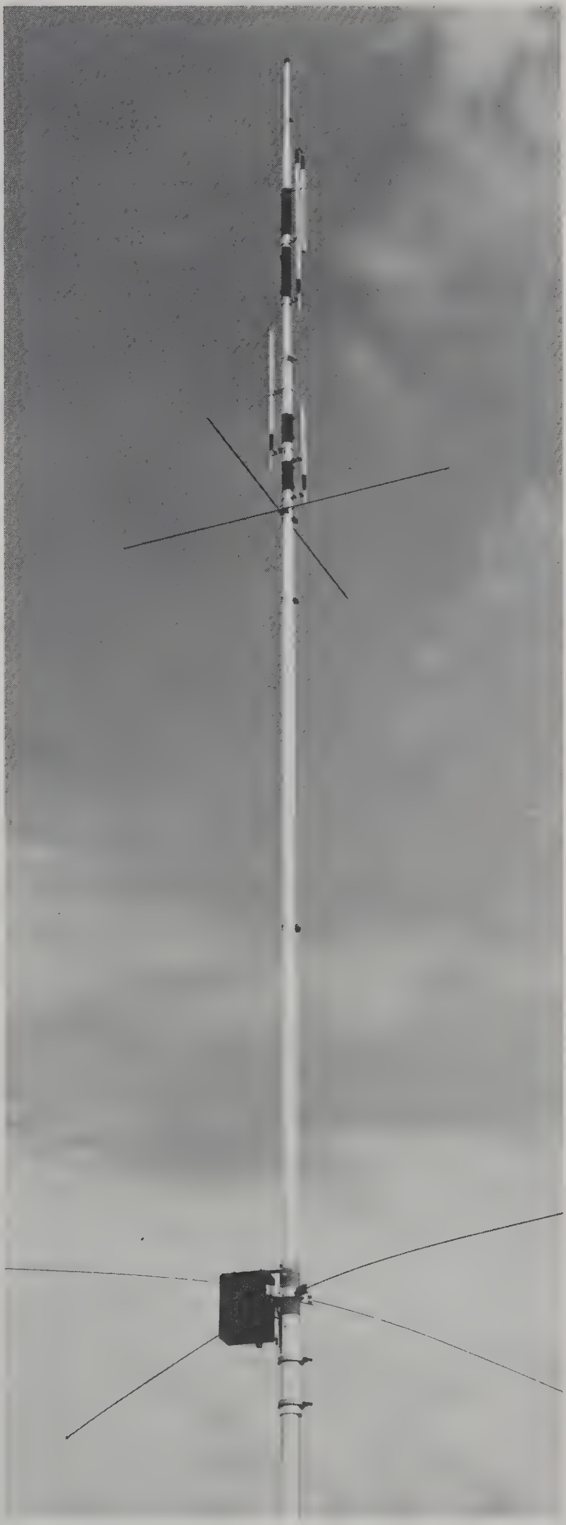
10, 12, 15, 17, 20 METERS

R5 is the latest, five band development of our highly succesful 1/2 wavelength, no ground radial vertical antennas. The design gives optimum current distribution for best low angle radiation and excellent DX. R5 brings high performance and "mount it anywhere" features to hams living in apartments, condominiums or on small city lots. If you're on the go with a motor home you'll really like this antenna.

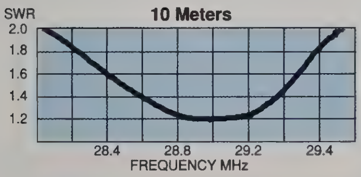
Even if you have plenty of space, R5's combination of neat appearance and no compromise DX capability make it ideal for your ham station.

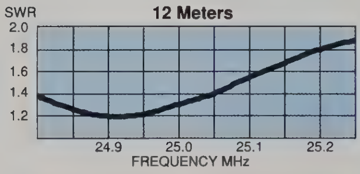
The new R5 has a broadband solid state impedance matching network for full coverage of all 5 bands. Frequency selection is completely automatic. There are no moving parts or remote tuner. The only connection to the antenna is your 50 Ohm coax.

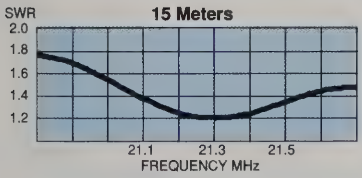
The unique counterpoise has four 48" long .100" diameter stainless steel rods for excellent ground isolation. This allows the antenna to be mounted anywhere from ground level to roof top. You've heard R5 antennas on the air, now you too can experience the latest antenna performance with the all new R5.

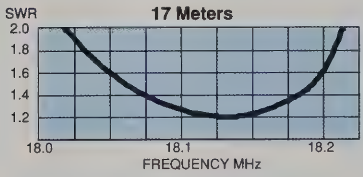


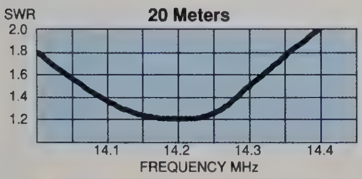
MODEL	R5
Frequency, Meters	10, 12, 15, 17, 20
Forward Gain, dBd	3
Electrical Wavelength	Half-wave
SWR 1.2:1 Typical	
2:1 Bandwidth	10 m-2 MHz / 12 m-100 KHz 15 m-450 KHz 17 m-200 KHz / 20 m-350 KHz
Power Rating, Watts PEP	1800
Radiation Angle, Degrees	16
Frequency Selection	Automatic
Horizontal Rad. Pattern Deg.	360°
Height, ft (m)	17 (5.5)
Mast Size Range, in (cm)	1.5-1.75 (3.8-4.4)
Wind Load, ft² (m²)	1.4 (.13)
Weight, lb (kg)	8.7 (4)
Mini Radials Supplied	Yes

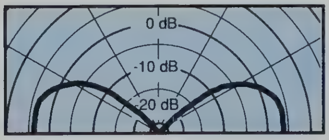












NEW R4 18 MHz CONVERSION KIT

If you are the owner of one of the very popular R4 antennas, our engineering hams give you the Cushcraft advantage. An easy to use upgrade kit which replaces your existing 15/17 meter trap plus new top section; it installs in minutes to give your R4 antenna full 5 band performance.

Model R45K

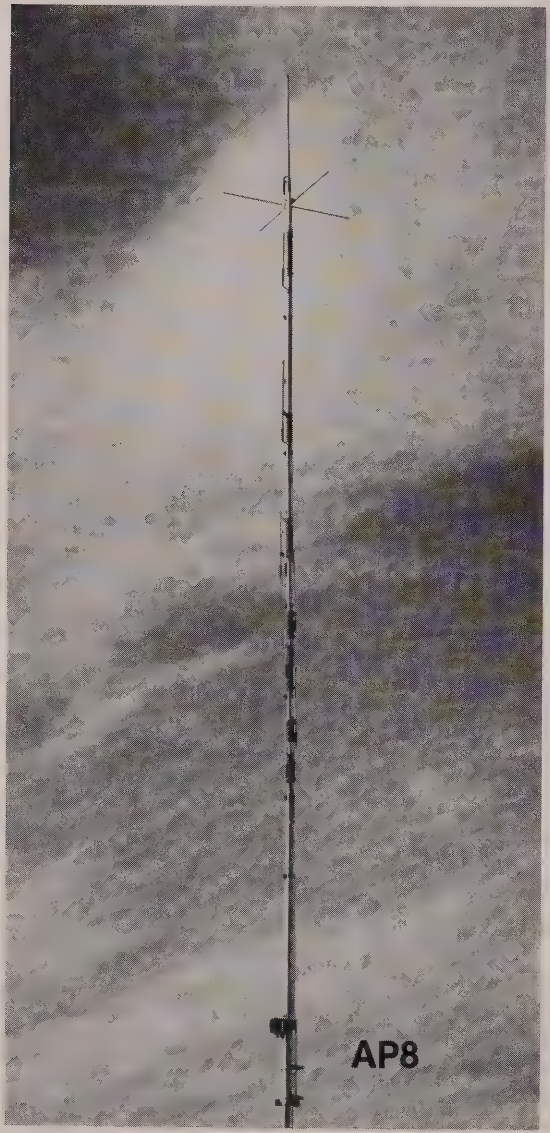
MULTIBAND HF VERTICALS

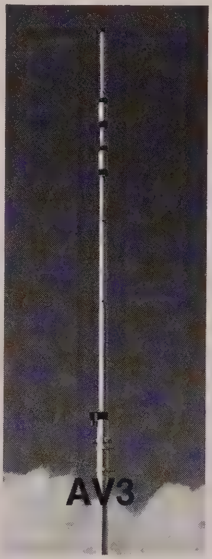
10 THRU 80 METERS

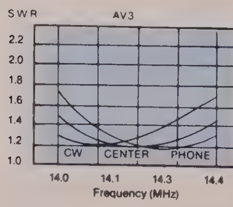
Up to eight bands await you with Cushcraft's popular multiband vertical antennas!

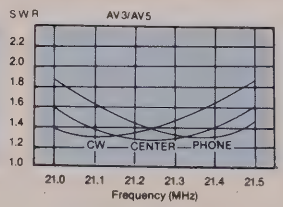
Multiband verticals are a cost-effective solution to the space problems that many of us face. Cushcraft Laser and Powerwave verticals are the right choice when a beam is not practical.

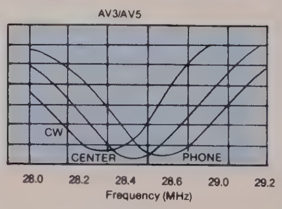
Our Lasers are economical yet offer good performance. They may be your first choice in multiband verticals because of their broadband performance, enclosed traps, and stainless steel hardware. Lasers are available in three-band and five-band models.











AP8 EIGHT BAND POWERWAVE
10, 12, 15, 17, 20, 30, 40, 80 Meters

The Powerwave is an eight band vertical that features compact traps, broadband performance, and great versatility. Heavy-duty construction and stainless steel hardware will keep your Powerwave radiating efficiently for years.

Every ham can appreciate the features of the AP8. More bands, greater efficiency, simple installation, and reasonable price make the AP8 an excellent choice.

Add our APR18 radial kit which includes pre-cut wire and connecting lugs. It helps make installation a snap! (The APR18 works with our Lasers, too, or any HF Vertical)

MODEL	**AP8**
Frequency, Meters	10,12,15,17,20,30,40,80
Electrical Wavelength	1/4
SWR 1.2:1 Typical	
2:1 Bandwidth	Full Band Except 40M > 150KHZ & 80M > 60KH
Power Rating, Watts PEP	2000
Radiation Angle Deg.	18
Freq Selection	Automatic
Horizontal Rad. Pattern Deg.	360
Height, ft(m)	<26(7.92)
Mast Size Range, in (cm)	1.5-1.75(3.8-4.4)
Wind Load, ft²(m²)	1.5(.14)
Weight, lb(kg)	9.3(4.2)
Radials Required	Normally
Radial Kit Avail	Yes, APR 18

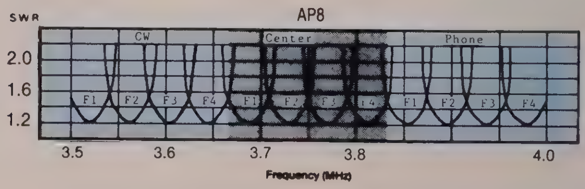
AV3 THREE BAND LASER

Our AV3 handles 10, 15, and 20 meters with fine performance and easy assembly. It has the same fine construction as the AV5.

AV5 FIVE BAND LASER

The AV5 works with the popular 10, 15, 20, 40, and 80 meter bands with broad bandwidth and full legal power. For versatility, this is the antenna for you!

MODEL	**AV3**	**AV5**
Frequency, Meters	20,15,10	80,40,20,15,10
Electrical Wavelength		
Each Band	¼	¼
SWR 1.2-1 Typical		
2:1 Bandwidth	Full Band	Full Band except 80M > 70 KHz
Power Rating, Watts PEP	2000	2000
Radiation Angle Deg.	18	18
Freq. Selection	Automatic	Automatic
Horizontal Rad. Pattern Deg.	360	360
Height, ft(m)	14(4.2)	25(7.4)
Mast Size Range, in.(cm)	1.5-1.75(3.8-4.4)	1.5-1.75(3.8-4.4)
Wind Load, ft²(m²)	1.02(.1)	1.89(.19)
Radials Required	Normally	Normally
Radial Kit Available	Yes, APR 18	Yes, APR 18



SKYWALKER MONOBAND HF YAGIS

10, 15 METERS

10 METERS

The three element model is a great selling antenna! If you have the space, and need the utmost in performance, then try our four element Skywalker. You can't go wrong with these contest winners, especially if you are a Novice new to ten meters!!

MODEL	**10-4CD**	**10-3CD**
Frequency, MHz	28.0-29.7	28.0-29.7
No. Elements	4	3
Forward Gain, dBd	10.0	8.0
Front to Back Ratio, dB	30	30
SWR 1.2:1 Typical		
2:1 Bandwidth KHz	>900	>1400
Power Rating, Watts PEP	2000	2000
3dB Beamwidth, Deg E Plane	56	57
Side Lobe Attenuation, dB	40	40
Boom Length, ft(m)	16 (4.88)	10 (3.05)
Boom Diameter, in(cm)	2.0 (5.08)	1.63-1.50 (4.1-3.8)
Longest Element, ft(m)	17.58 (5.34)	17.66(5.38)
Element Center Dia, in(cm)	.88-.63(2.2-1.6)	.88-.63(2.2-1.6)
Turning Radius, ft(m)	11.5 (3.5)	10(3.05)
Mast Size Range in(cm)	1.5-2.0(3.8-5.1)	1.5-2.0(3.8-5.1)
Wind Load, ft²(m²)	3.1(.29)	2.3(.21)
Weight, lb(kg)	18(8.16)	11(5.00)

15 METERS

These two Skywalkers will keep you enthusiastic about 15 meters. Our three element model gives fine performance in limited areas. For maximum gain, select the four-element model with its new 2″ diameter boom! Or, try stacking two four element Skywalkers for incredible performance! Reddi-match tuning makes it easy.

The 10dB forward gain of our 15-4CD is the result of computer design and will keep you first in line during pileups!

MODEL	**15-4CD**	**15-3CD**
Frequency, MHz	21.0-21.45	21.0-21.45
No. Elements	4	3
Forward Gain, dBd	10.0	8.0
Front to Back Ratio, dB	30	30
SWR 1.2:1 Typical		
2:1 Bandwidth, KHz	500	500
Power Rating, Watts PEP	2000	2000
3dB Beamwidth, Deg E Plane	56	57
Side Lobe Attenuation, dB	>40	>40
Boom Length, ft(m)	20(6.10)	14(4.27)
Boom Diameter, in(cm)	2.0 (5.08)	2.0 (5.08)
Longest Element, ft(m)	23.33(7.11)	23.16(7.06)
Element Center Dia, in(cm)	1(2.5)	1(2.5)
Turning Radius, ft(m)	15.5(4.72)	13.50(4.11)
Mast Size Range in(cm)	1.5-2.0(3.8-5.1)	1.5-2.0(3.8-5.1)
Wind Load, ft²(m²)	4.5(.42)	3.4(.32)
Weight, lb(kg)	25(11.34)	20(9.07)

More Performance Than You Ever Imagined

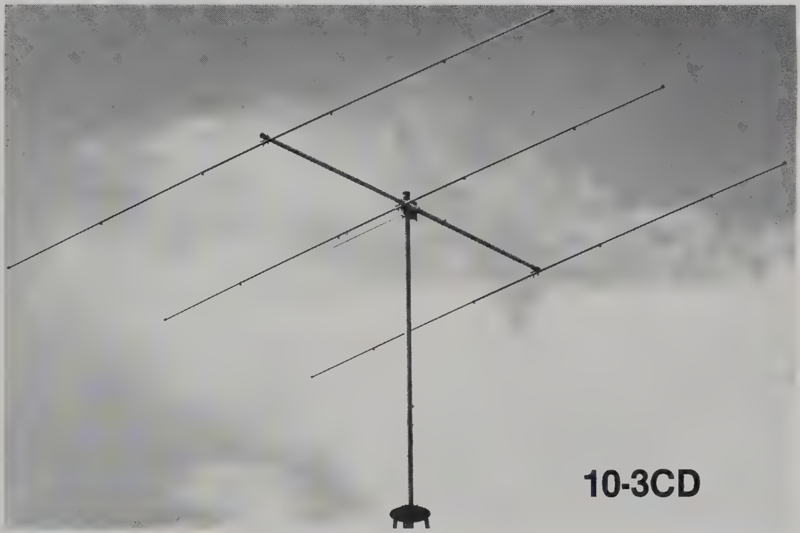
More contacts, less waiting, less interference, and a better signal at the other end are yours with a Skywalker!

Computer-aided design helped us maximize forward gain while reducing sidelobes and SWR. And our 50 ohm Reddi-match feed uses a UHF SO-239 for easy connection.

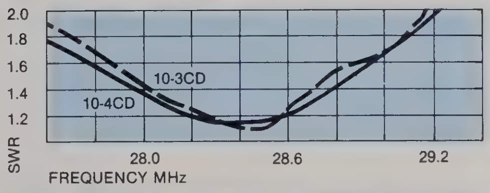
Construction features include improved larger diameter pinned booms with fewer sections, heavy-wall heat treated 6063-T832 aluminum tubing, stainless steel fasteners, worm drive element clamps, and carefully formed aluminum brackets.

Assembly is easy and installation can often be done by one person!

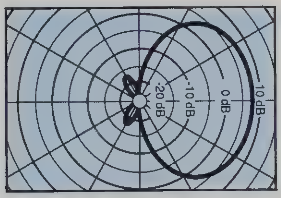
Skywalkers are contest winners. One of these fine antennas is perfect for you.



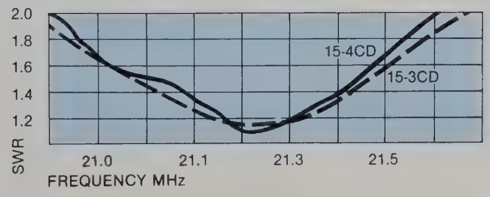
10-3CD



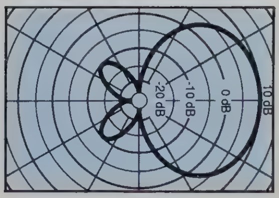
TYPICAL 3 ELEMENT PATTERN



15-4CD

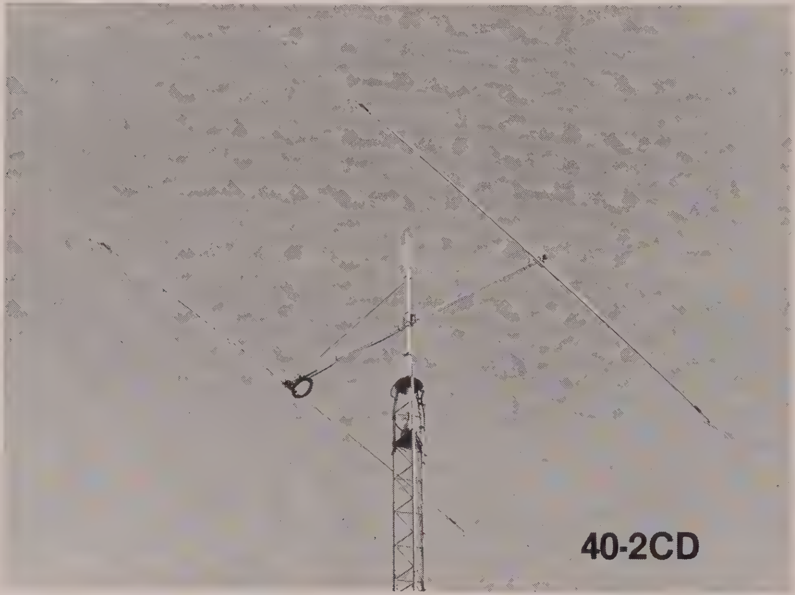


TYPICAL 4 ELEMENT PATTERN

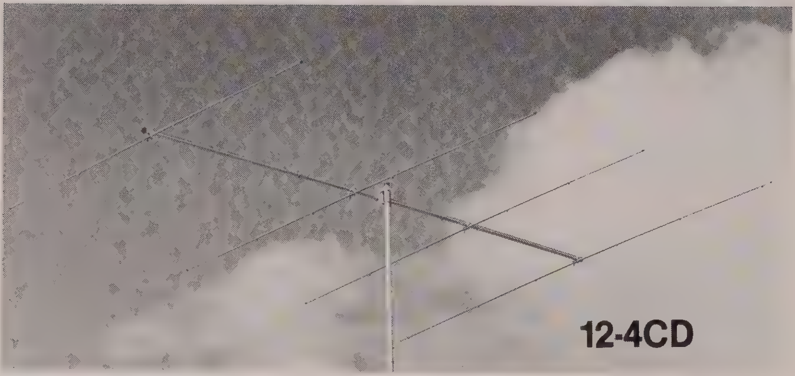


MORE SKYWALKERS

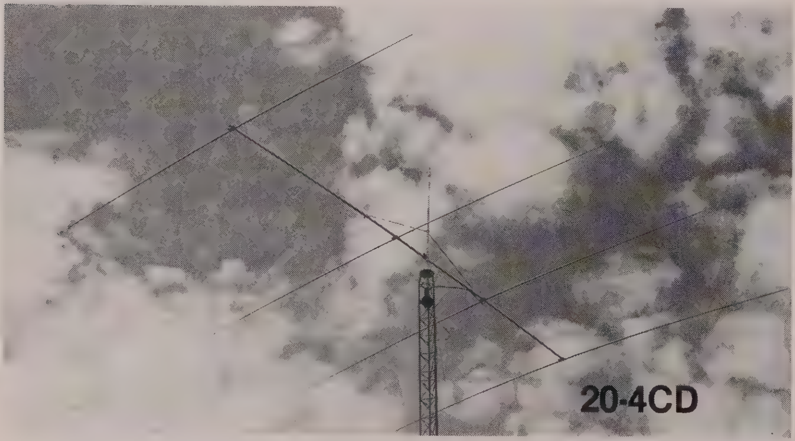
12, 20, 40 METERS



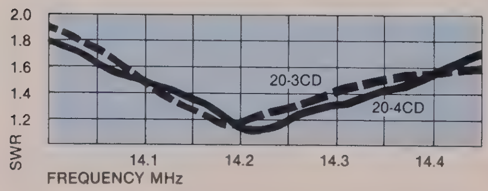
40-2CD



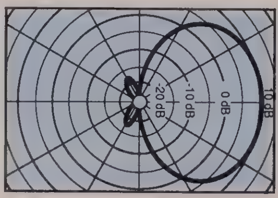
12-4CD



20-4CD



TYPICAL 4 ELEMENT PATTERN



12 METERS

We've got the right antenna for you! Our new four element 12 meter Skywalker will help you get the most out of this new band.

You will appreciate the fine construction features of the 12-4CD such as heat-treated 6063-T832 heavy aluminum tubing.

40 METERS

This Skywalker holds the North American contact record for 40 meters. A two element compact antenna, it has the performance that you want for 7 MHz work. The dipole center insulator is heavy duty with a twin terminal 50 Ohm connection. It's the most popular 7 MHz beam!

MODEL	40-2CD	12-4CD
Frequency, MHz	7.0-7.3	24.89-24.99
No. Elements	2	4
Forward Gain, dBd	5.5	10.0
Front to Back Ratio, dB	20	30
SWR 1.2:1 Typical 2:1 Bandwidth, KHz	200	100
Power Rating, Watts PEP	2000	2000
3dB Beamwidth, Degrees E Plane	70	59
Side Lobe Attenuation	>40	>40
Boom Length, ft (m)	23(6.9)	18(5.5)
Boom Diameter, in (cm)	2.13-1.88(5.4-4.8)	2 (5.1)
Longest Element, ft (m)	43 (12.9)	20.17 (6.15)
Element Center Dia.in (cm)	1.25 (3.1)	.875 (2.2)
Turning Radius, ft (m)	23.93 (7.29)	14.8 (4.52)
Mast Size Range, in (cm)	1.5-2(3.8-5.1)	1.5-2(3.8-5.1)
Wind Load, ft² (m²)	6.38 (.57)	3.9 (.36)
Weight, lb (kg)	44 (19.8)	21 (9.5)

20 METERS

Our four-element 20 meter Skywalker and its three element compact version will punch your signal through the QRM.

Stainless steel fasteners and double U-bolt brackets ensure that your antenna will last for years.

MODEL	20-3CD	20-4CD
Frequency, MHz	14.0-14.35	14.0-14.35
No. Elements	3	4
Forward Gain, dBd	8.0	10.0
Front to Back Ratio, dB	30	30
SWR 1.2:1 Typical 2:1 Bandwidth, KHz	>300	>400
Power Rating, Watts PEP	2000	2000
3dB Beamwidth, Degrees E Plane	57	56
Side Lobe Attenuation, dB	>40	>40
Boom Length, ft (m)	20 (6.1)	32 (9.75)
Boom Diameter, in (cm)	2.0 (5.08)	2.13-1.88(5.4-4.8)
Longest Element, ft (m)	35.95(10.96)	36.08 (11.00)
Element Center Dia.in (cm)	1.25 (3.1)	1.25 (3.1)
Turning Radius, ft (m)	20 (6.1)	23.75 (7.2)
Mast Size Range, in (cm)	1.5-2(3.8-5.1)	1.5-2(3.8-5.1)
Wind Load, ft² (m²)	5.5 (.51)	8.1 (.75)
Weight, lb (kg)	30 (13.61)	55 (24.95)

BOOMER SIDEBAND/CW YAGIS

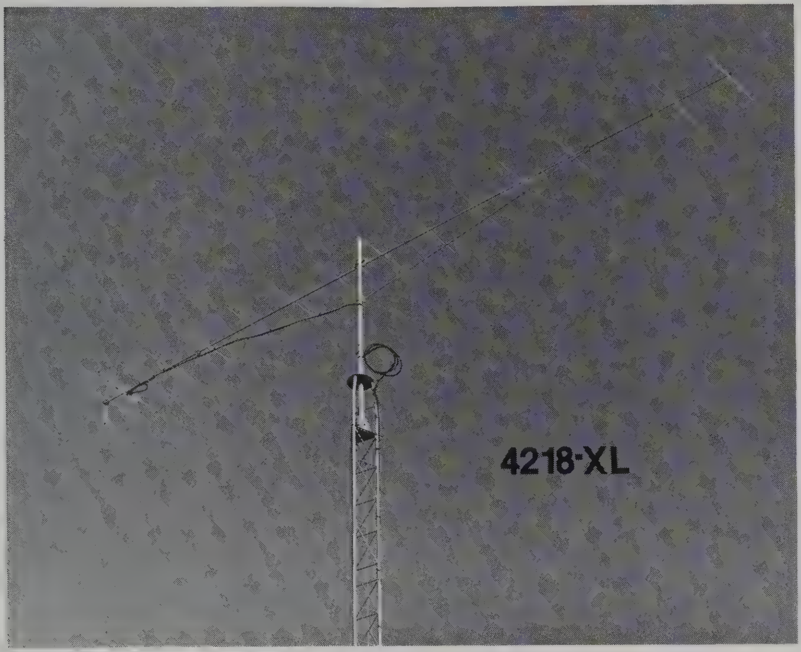
2 METERS

Known the World Over.

Boomers have established EME contest records. They have won every antenna measuring contest comparison and have set many new distance operating records!

Knowledgeable hams select Boomers for their VHF and UHF sideband and CW work. There is nothing like them! They are easy to stack for even more performance.

Try a Boomer. And be prepared for the best contacts that you have ever made!



Cushcraft developed four antennas for you to select from for two meters. One of these is right for your favorite two meter activity!

Ready for the best DX you have ever worked? Our 4218XL is **the** antenna for the experienced VHF-er. Range tests and contesting have proven this model's high gain and clean pattern!

Our step-tapered boom keeps the wind load low, while tubular support braces, and stainless steel hardware add to this antenna's long life and keep the XL on the air. Like all Boomers, elements are solid aluminum rod. The Boomer T-match with 4:1 coaxial balun for precise matching is a standard feature.

Is space a problem? You can still have high performance with our very popular 32-19 Boomer. Its shorter boom fits just about anywhere yet its gain is still over 16 dBd.

Or perhaps you want wide-band performance. Then the Cushcraft 215WB is the antenna for you! Good gain across the 144-148 MHz frequency range makes this model our most versatile 2 meter antenna.

Trigon reflectors (except the 124WB), a balanced T-Match feed system, and 4:1 baluns are included with these fine antennas.

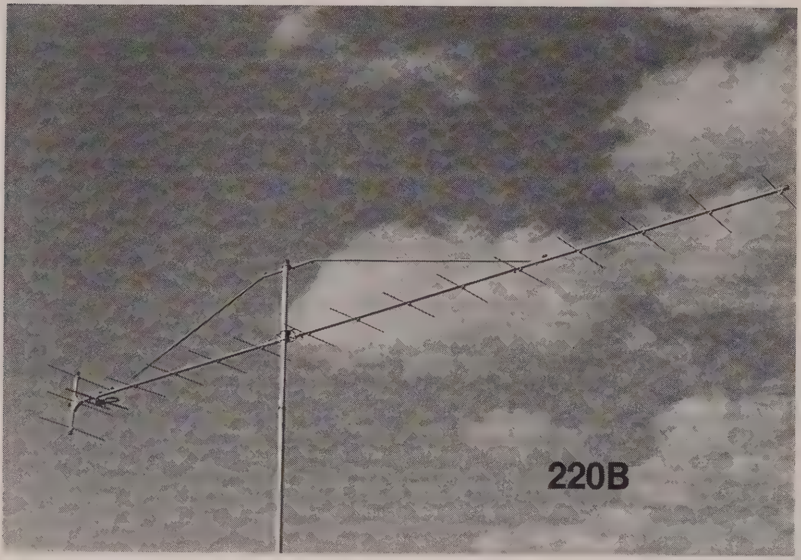
MODEL	**32-19**	**4218XL**
Frequency, MHz	144-146	144-145
No. Elements	19	18
Forward Gain, dBd	16.2	17.2
Front to Back Ratio, dB	24	24
SWR 1.2:1 Typical 2:1 Bandwidth KHz	>2	>1
Power Rating, Watts PEP	2000	2000
3 dB Beamwidth, Degrees		
E Plane	2 x 14	2 x 13
H Plane	2 x 17	2 x 14.5
Side Lobe Attenuation, dB E Plane	60	60
Boom Length, ft(m)	22(6.71)	28.8(8.78)
Electrical Wavelength	3.2	4.2
Longest Element, in.(cm)	40(101.6)	40(101.6)
Turning Radius, ft(m)	11(3.35)	16.66(5.08)
Mast Size Range in (cm)	1.5-2(3.8-5.1)	1.5-2(3.8-5.1)
Wind Load, ft^2(m^2)	3.5(.33)	3.5(.33)
Weight, lb(kg)	12(5.44	14.3(6.5)

MODEL	**124WB**	**215WB**
Frequency MHz	144-148	144-148
No. Elements	4	15
Forward Gain, dBd	10.2	15.5
Front to Back Ratio, dB	24	24
SWR 1.2:1 Typical 2:1 Bandwidth, KHz	>4	>4
Power Rating, Watts PEP	2000	2000
3dB Beamwidth, Degrees		
E Plane	60	2 x 17
H Plane	83	2 x 18
Side Lobe Attenuation, dB E Plane	40	60
Boom Length, ft(m)	4(1.22)	15(4.57)
Electrical Wavelength	.5	2.2
Longest Element, in (cm)	40.75(104)	39.5(100)
Turning Radius, ft(m)	4(1.22)	7.5(2.29)
Mast Size Range in (cm)	1.24-2(3.2-5.1)	1.5-2(3.8-5.1)
Wind Load, ft^2(m^2)	.34(.034)	1.7(.16)
Weight, lb(kg)	3(1.36)	8(3.63)

Boomer stacking kit information on page 16

MORE BOOMERS

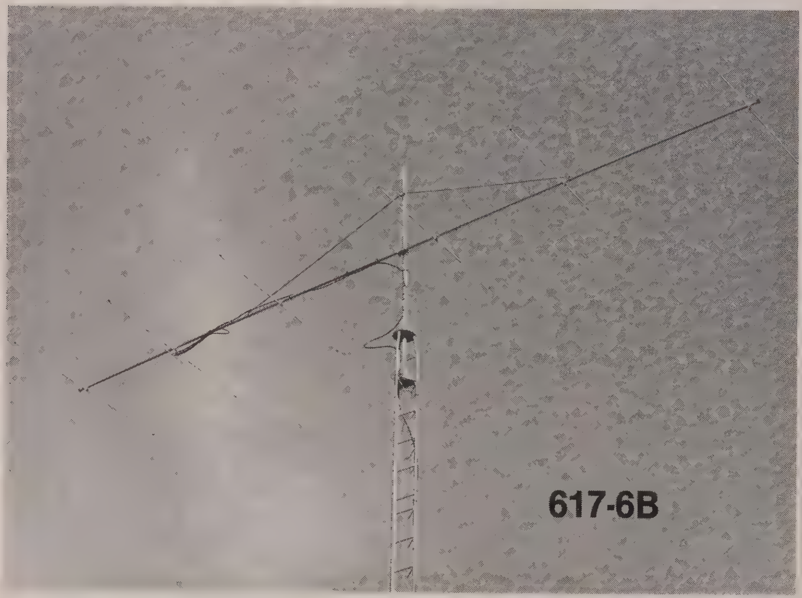
6, 1¼ METERS, 70 CM



1¼ METERS

We took the features of our 2 meter antennas and incorporated them into a high-gain 1¼ meter antenna that is perfect for this fast growing band. You will have more fun with Cushcraft!

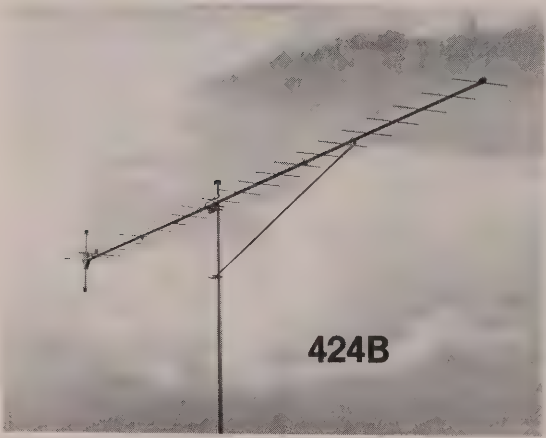
MODEL	**220B**
Frequency	220-223
No. Elements	17
Forward Gain, dBd	17.2
Front to Back Ratio, dB	30
SWR 1.2:1 Typical	
2:1 Bandwidth,MHz	>1
Power Rating, Watts PEP	2000
3dB Beamwidth Degrees	
E Plane	2 x 13
H Plane	2 x 14
Side Lobe Attenuation,	
dB E Plane	60
Boom Length, ft(m)	19(5.8)
Electrical Wavelength	4.2
Longest Element, in (cm)	26(66.2)
Turning Radius, ft(m)	9(2.64)
Mast Size Range in (cm)	1.5-2(3.8-5.1)
Wind Load, ft²(m²)	2.6(.24)
Weight, lb(kg)	10.5(4.77)



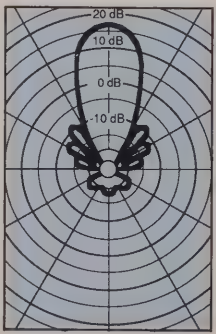
6 METERS

Our 617-6B has more gain than any antenna in its class! The serious six meter operator will appreciate the features of this great-performing boomer. Find out for yourself!

MODEL	**6176B**	**424B**
Frequency	50-51	424-435
No. Elements	6	24
Forward Gain, dBd	14.0	18.2
Front to Back Ratio, dB	30	30
SWR 1.2:1 Typical		
2:1 Bandwidth, MHz	>1	>12
Power Rating, Watts PEP	2000	2000
3dB Beamwidth Degrees		
E Plane	2 x 19	2 x 9.5
H Plane	2 x 20	2 x 11
Side Lobe Attenuation,		
dB E Plane	60	60
Boom Length, ft(m)	34(10.36)	17.4(5.3)
Electrical Wavelength	1.7	7.6
Longest Element, in (cm)	117(297.2)	13(33.8)
Turning Radius, ft(m)	17.7(5.39)	10(3.05)
Mast Size Range in (cm)	1.5-2(3.8-5.1)	1.5-2(3.8-5.1)
Wind Load, ft²(m²)	4.8(.45)	2.3(.21)
Weight, lb(kg)	26(11.79)	4.5(2.05)



TYPICAL RADIATION PATTERN



70 CM

The contest winner! The 424B will keep **you** at the top of the charts.

Through-the-boom insulated elements, precise spacing, and high efficiency reflector systems are the features that make our 70 CM antennas the right choice for every ham.

The 424B has an eye-opening 18.2 dBd forward gain for the ultimate in 70 CM enjoyment.

These boomers are equipped with stainless steel hardware, UV stabilized insulators, teflon dielectric coaxial balun, seamless heavy-wall booms, and 50 ohm N connector.

Equip yourself or fun and challenge of 70 CM with a Cushcraft Boomer!

cushcraft
CORPORATION
THE ANTENNA COMPANY

AMATEUR ANTENNA PRICE SCHEDULE

48 PERIMETER ROAD, MANCHESTER, NH 03108 603-627-7877 / TELEX 4949472 / FAX 603-627-1764

	MODEL	DESCRIPTION	SHIP WT	LIST PRICE

MULTIBAND HF BEAM ANTENNAS

	A3	14,21,28 MHz 3 element	29	$399.00
	A3SK	Stainless Steel Hardware kit for A3	5	$45.00
	A4S	14,21,28 MHz 4 el stainless hardware	38	$525.00
	A743	7 & 10 MHz Add On Kit for A3	7	$128.00
	A744	7 & 10 MHz Add On Kit for A4	7	$128.00

MULTIBAND HF VERTICAL ANTENNAS

	AP8	3.5, 7, 10, 14, 18, 21, 24, 28 MHz	12	$235.00
	AV3	14, 21, 28 MHz	7	$98.00
	AV5	3.5, 7, 14, 21, 28 MHz	10	$180.00
N	R45K	R4 17 Mtr Kit for R4 (3/24/89)	5	$45.00
N	R5	10/12/15/17/20 m, halfwave (4/18/89)	12	$340.00
	APR18	8 Band Radial Kit	3	$46.00

BOOMER ANTENNAS

	124WB	144-148 MHz 4 element	5	$60.00
	224WB	220-225 MHz 4 element	3	$55.00
	225WB	220-225 MHz 15 element	6	$120.00
	215WB	144-148 MHz 15 element	10	$130.00
	220WB	220-223 MHz 17 element	12	$160.00
	230WB	144-148 MHz 30 element	40	$350.00
	3219	144-146 MHz 19 element	13	$180.00
	424B	432-434 MHz 24 element	7	$130.00
	4218XL	144-146 MHz 18 element	17	$210.00
	617-6B	50-51 MHz 6 element	35	$350.00

RINGO RANGER II ANTENNAS

	ARX-2B	134-164 MHz Ringo Ranger II	4	$60.00
	ARX-220B	220-225 MHz Ringo Ranger II	3	$60.00
	ARX-450B	435-470 MHz Ringo Ranger II	3	$60.00
	ARX-450BN	435-470 MHz Ringo Ranger II, N Conn	3	$72.00

RINGO ANTENNAS

	AR-2	135-170 MHz Ringo	3	$40.00
	AR-6	50-54 MHz Ringo	4	$60.00
	AR-10	28-29.7 MHz Ringo	5	$60.00
	AR-220	220-225 MHz Ringo	2	$40.00
	AR-450	440-460 MHz Ringo	2	$40.00

RINGO RANGER ANTENNAS

	ARX-2	135-170 MHz Ringo Ranger	3	$50.00

ACCESSORIES

	AFB-2	Broadband Balun 3.5-29 MHz	2	$50.00
	LAC-1	Coax Lightning Arrester	1	$9.00
	LAC-2	Coax Lightning Arrester	1	$9.00
	LAC-4	200 Watt UHF Conn Gas Tube Arrester	2	$36.00
	LAC4H	2KW UHF Conn Gas Tube Arrester	2	$38.00
	LAC4N	200 Watt N Conn Gas Tube Arrester	2	$46.00
	LAC4NH	2 KW N Conn Gas Tube Arrester	2	$48.00
	LC2	200 Watt Cartridge for LAC4, LAC4N	1	$14.00
	LC2KW	2 KW Cartridge for LAC4H, LAC4NH	1	$16.00
	5VB	5 Vinyl Connector Boots	1	$10.00

MOBILE ANTENNAS

	CS50	50-54 MHz 3/4" Hole Mount	3	$50.00
	CS50M	50-54 MHz Magnetic Mount	3	$58.00
	CS50T	50-54 MHz Trunk Lip Mount	3	$58.00
	CS147	144-174 MHz 3/4" Hole Mount	3	$50.00
	CS147M	144-174 MHz Magnetic Mount	3	$58.00

MOBILE ANTENNAS (CONT.)

	MODEL	DESCRIPTION	SHIP WT	LIST PRICE
	CS147T	144-174 MHz Trunk Lip Mount	3	$58.00
	CS220	220-225 MHz 3/4" Hole Mount	3	$50.00
	CS220M	220-225 MHz Magnetic Mount	3	$58.00
	CS220T	220-225 MHz Trunk Lip Mount	3	$58.00
	CS450	435-450 MHz 3/4" Hole Mount	3	$50.00
	CS450M	435-450 MHz Magnetic Mount	3	$58.00
	CS450T	435-450 MHz Trunk Lip Mount	3	$58.00
	CS147A	144-174 MHz Coil & Whip only	3	$39.00
	CS450A	435-450 MHz Coil & Whip only	3	$39.00
N	CS28M	28 MHz Magnetic Mount (4/12/89)	3	$58.00
	CSMG	Magnetic Mount	5	$26.00
	CSTL	Trunk Lip Mount takes 3/4" Coil	5	$26.00

PORTABLE ANTENNAS NEW RUGGED

	BN141RD	144-148 MHz, 6" for Icom, Yeasu	1	$18.00
	BN141RS	144-148 MHz, 3" for Icom, Yeasu	1	$18.00
	BN22ORB	220-225 MHz, 6" for Icom, Yeasu	1	$18.00
	BN220RC	220-225 MHz, 2" for Icom, Yeasu	1	$18.00
	BN440RB	430-450 MHz, 6" for Icom, Yeasu	1	$18.00
	BN440RC	430-450 MHz, 2" for Icom, Yeasu	1	$18.00

PORTABLE ANTENNAS FOR KENWOOD

	TK141	144-148 MHz, 6"	1	$16.00
	TK141S	144-148 MHz, 3"	1	$16.00
	TK220B	220-225 MHz, 6"	1	$16.00
	TK220C	220-225 MHz, 3"	1	$16.00
	TK440B	430-450 MHz, 6"	1	$16.00
	TK440C	430-450 MHz, 2"	1	$16.00

SKYWALKER HF BEAM ANTENNAS

	10-3CD	28 MHz 3 element	15	$185.00
	10-4CD	28 MHz 4 element	25	$235.00
	12-4CD	12 MHz 4 element	20	$250.00
	15-3CD	21 MHz 3 element	22	$240.00
	15-4CD	21 MHz 4 element	30	$285.00
	20-3CD	14 MHz 3 element	40	$350.00
	20-4CD	14 MHz 4 element 2 cartons	55	$500.00
	40-2CD	7 MHz 2 element 2 cartons	46	$520.00
N	TEN-3	28 MHz 3 element (4/20/89)	10	$125.00

FM YAGI ANTENNAS

	A147-4	146-148 MHz 4 element	3	$50.00
	A147-11	146-148 MHz 11 element	6	$75.00
	A147-20T	144 & 147 MHz 20 element	7	$95.00
	A147-22	146-148 MHz 22 element	14	$215.00
	A220-7	220-225 MHz 7 element	4	$45.00
	A220-11	220-225 MHz 11 element	4	$80.00
	A449-6	449 MHz 440-450 MHz 6 element	4	$48.00
	A449-11	449 MHz 440-450 MHz 11 element	5	$65.00

FM YAGI STACKING KITS

	A14-SK	Stacking Harness for two A147-4	2	$39.00
	A14-VPK	Vert. Pol. Kit for two A147-4	5	$53.00
	A21-SK	Stacking Harness for two A220-11	2	$39.00
	A220-VPK	Vert. Pol. Kit for two A220-11	5	$53.00
	A147-SK	Stacking Harness for two A147-11	2	$39.00
	A147-VPK	Vert. Pol. Kit for two A147-11	5	$85.00
	A449-SK	Stacking Harness for two A449-6 or 11	2	$39.00
	A449-VPK	Vert. Pol. Kit for two A449-6 or 11	5	$53.00

AVAILABLE THROUGH DEALERS WORLDWIDE

N New Product

MODEL	DESCRIPTION	SHIP WT	LIST PRICE
VHF/UHF BEAM ANTENNAS			
A50-3	50-51 MHz 3 element beam	8	$90.00
A50-5	50-51 MHz 5 element beam	12	$145.00
A50-6	50-51 MHz 6 element beam	22	$240.00
A144-7	144-146 MHz 7 element beam	4	$48.00
A144-11	144-146 MHz 11 element beam	6	$75.00
A430-11	430-435 MHz 11 element beam	4	$65.00
VHF/UHF STACKING KITS			
A11-SK	Stacking Harness for two A144-11	2	$39.00
A17-SK	Stacking Harness for two A144-7	2	$39.00
A41-SK	Stacking Harness for two A430-11	2	$39.00
A535-SK	Stacking Harness for two A50-3/A50-5	3	$39.00
A561-SK	Stacking Harness for two A50-6	4	$50.00
FOUR POLE ARRAYS			
AFM-4DA	144-148 MHz Four Pole	6	$118.00
AFM-24DA	220-225 MHz Four Pole	5	$105.00
AFM-44DA	440-450 MHz Four Pole	5	$90.00
OSCAR ANTENNAS			
A14T-MB	Twist Mounting Boom & Bracket	3	$40.00
A144-10T	145 MHz 10 element	5	$85.00
A144-20T	145 MHz 20 element	10	$125.00
AOP-1	Complete Oscar Pack	14	$250.00
416TB	435-437 MHz Twist 16 element	6	$100.00
PS4	Remote Polarity Switch, Req. 12V DC	3	$125.00

	MODEL	DESCRIPTION	SHIP WT	LIST PRICE
	WORLD RANGER ROTATABLE DIPOLE ANTENNAS			
	D3	14,21,28 MHz	11	$195.00
N	D3W	10/12/17 Mtr Dipole (4/25/89)	12	$200.00
	D4	7, 14, 21, 28 MHz	14	$265.00
	D40	7 MHz	16	$235.00
	DX ARRAYS			
	DX-120	144-148 MHz 20 element colinear	8	$120.00
	DX-420	420-440 MHz 20 element colinear	6	$80.00
	DX ARRAY BALUNS			
	DX-1BN	1-1 Balun for DX-120	2	$29.00
	DX-4BN	1-1 Balun for DX-420	2	$27.00
	BOOMER STACKING KITS POWER DIVIDERS			
	PD-2	Power Divider Two 215WB, 3219, 4218XL	5	$38.00
	PD-4	Power Divider Four 215WB, 3219, 4218XL	5	$48.00
	PD-222	Power Divider, Two 220B	5	$38.00
	PD-224	Power Divider, Four 220B	5	$48.00
	22-SK	Stacking Harness & P.D., Two 215WB	7	$75.00
	32-SK	Stacking Harness & P.D., Two 3219	7	$80.00
	42-SK	Stacking Harness & P.D., Two 4218XL	7	$85.00
	220-SK	Stacking Harness & P.D., Two 220B	7	$75.00
	220-QK	Quad Stacking Kit, Four 220B	35	$375.00
	224-QK	Quad Stacking Kit, Four 215WB	35	$375.00
	230-VPK	Vert. Pol. Kit, Two 215WB	15	$165.00
	324-QK	Quad Stacking Kit, Four 3219	50	$550.00
	617-SK	Stacking Harness & P.D., Two 617-6B	10	$125.00

AVAILABLE THROUGH DEALERS WORLDWIDE

cushcraft
CORPORATION
THE ANTENNA COMPANY

48 PERIMETER ROAD, MANCHESTER, NH 03108
603-627-7877 / TELEX 4949472 / FAX 603-627-1764

BOOMER FM YAGIS

1¼, 2 METERS

We've Got FM covered

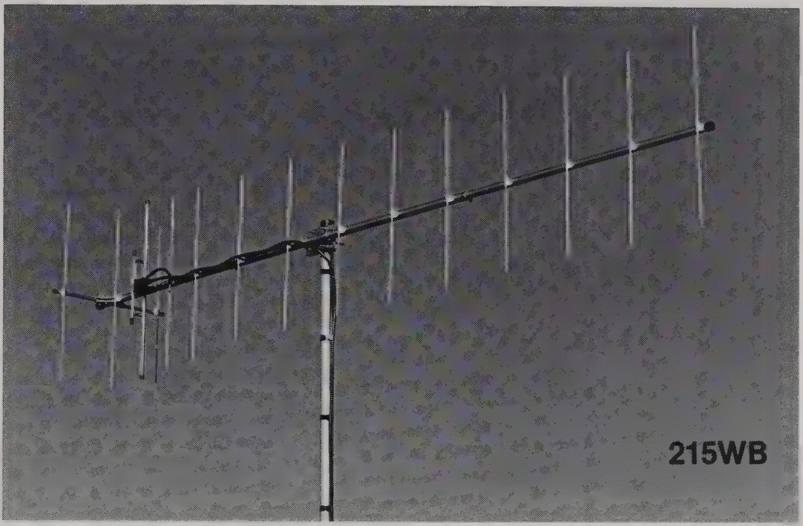
Our FM Boomers feature the latest wideband technology and provide the high performance that you want for FM work. And if you are into packet, our Boomers will punch your signal through.

For example, our 215WB two meter model is perfect for capturing distant repeaters thanks to its high-performance computer design. You will even use it for working tropo on SSB or EME on CW! It's that good!

Now take a look at our 230WB. It is the highest gain two-meter FM antenna in the world. It has performance with a capital "P."

And our other FM Boomers can be counted on, too. Find the band that you want to work, and then order one of our Boomers. It could be the best decision you ever made.

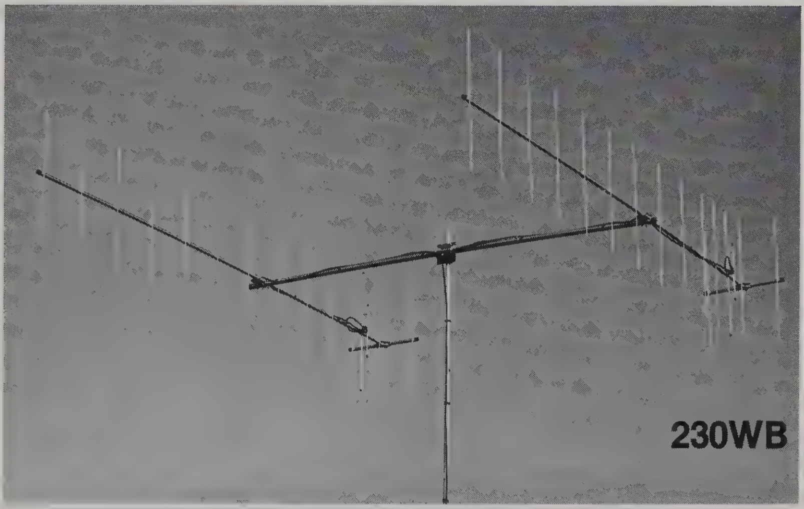
The 224WB and 225WB are perfect for the Novice phone band!


215WB

MODEL	124WB	215WB	230WB
Frequency	144-148	144-148	144-148
No. Elements	4	15	30
Forward Gain, dBd	10.2	15.2	18.5
Front to Back Ratio, dB	24	24	24
SWR 1.2:1 Typical			
2:1 Bandwidth, MHz	>4	>4	>4
Power Rating, Watts PEP	2000	2000	2000
3dB Beamwidth, Degrees			
E Plane	60	2x17	2x18
H Plane	83	2x18	2x9
Side Lobe Attenuation,			
dB E Plane	40	60	60
Boom Length, ft (m)	4 (1.22)	15 (4.57)	15 (4.57)
Electrical Wavelength	.5	2.2	2.2
Longest Element, in (cm)	40.75 (104)	39.5 (100)	39.5 (100)
Turning Radius, ft (m)	4 (1.22)	7.5 (2.29)	9.5 (2.9)
Mast Size Range, in (cm)	1.25-2 (3.2-5.1)	1.5-2 (3.8-5.1)	1.5-2 (3.8-5.1)
Wind Load, ft² (m²)	.34 (.034)	1.7 (.16)	4.0 (.37)
Weight, lb (kg)	3 (1.36)	8 (3.63)	22 (9.98)

124WB

MODEL	224WB	230WB
Frequency	220-225	220-225
No. Elements	4	15
Forward Gain, dBd	10.2	15.5
Front to Back Ratio, dB	24	24
SWR 1.2:1 Typical		
2:1 Bandwidth, MHz	>5	>5
Power Rating, Watts PEP	2000	2000
3dB Beamwidth, Degrees		
E Plane	83	2x18
H Plane	60	2x17
Side Lobe Attenuation,		
dB E Plane	40	60
Boom Length, ft (m)	3 (.91)	10 (3.05)
Electrical Wavelength	0.5	2.2
Longest Element, in (cm)	26.7 (68)	26.3 (67)
Turning Radius, ft (m)	2.75 (.84)	5.8 (1.78)
Mast Size Range, in (cm)	1.25-2 (3.2-5.1)	1.25-2 (3.2-5.1)
Wind Load, ft² (m²)	.23 (.021)	.95 (.09)
Weight, lb (kg)	1.7 (.77)	5.25 (2.4)


230WB

RINGO AND RINGO RANGER II

70 CM, 1¼, 2, 6, 10 METERS

Our Ringos are Number One

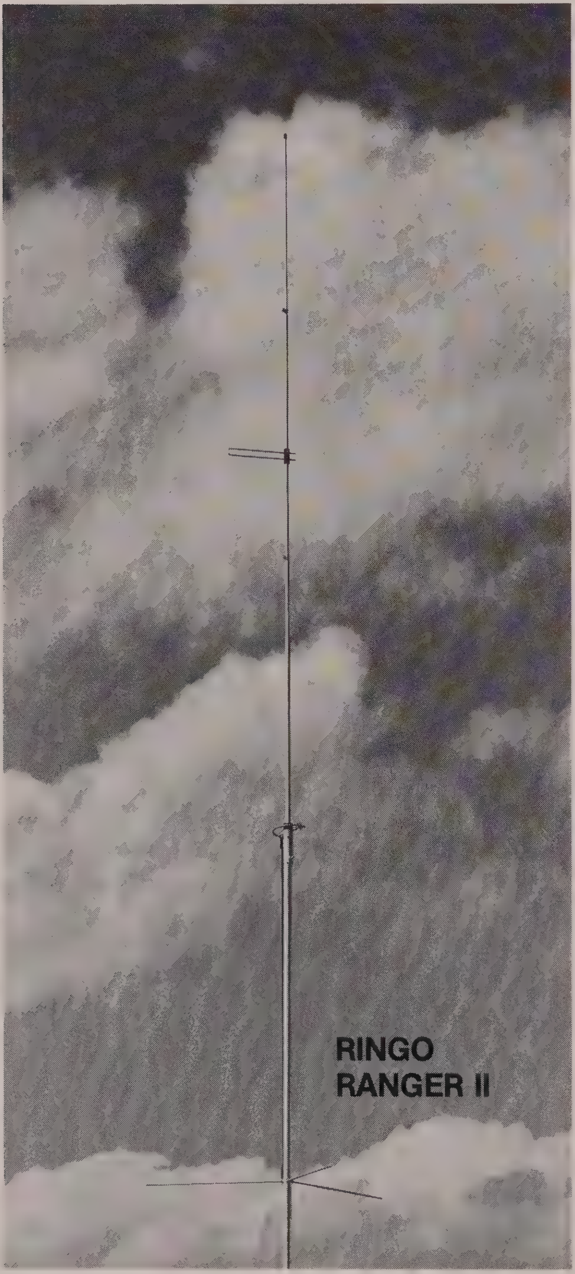
Our Ringo Ranger II has more gain, less windload, and more mechanical integrity than other two meter antennas. You will quickly appreciate the benefits of this amazing antenna!

Based on the original W1BX Ringo, the Ringo Ranger II is the latest design featuring three ⅝ wave radiating elements and an adjustable ⅛ wave phasing stub. The result is a very low angle of radiation over your coverage area.

Plus, the Ringo Ranger II has built-in lightning protection, UV stabilized insulators, heavy wall tubing, improved decoupling radials to eliminate feedline radiation, and all-weather performance.

Ringo Ranger II. It's the performer. Over 500,000 have been sold!

The ARX-450BN has all the features of the standard antenna plus N connector.



MODEL	**ARX-2B**	**ARX-220B**	**ARX-450B**
Frequency, MHz	135-160	220-225	435-450
SWR 1.2:1 Typical 2:1 Bandwidth, MHz	>3	>5	>10
Gain dB	7.0	7.0	7.0
Power Rating, Watts FM	1000	500	500
Radiation Angle, Deg.	7	7	7
Horizontal Radiation Pattern Deg.	360	360	360
Ring Diameter in(cm)	5(12.7)	5(12.7)	3.5(8.9)
Radiator Base Dia, in (cm)	.75 (1.9)	.75(1.9)	.50(1.2)
Height, ft(m)	14(4.3)	9.3(2.8)	4.9(1.5)
Mast Size Range, in (cm)	1.25(3.2)	1.25(3.2)	1(2.5)
Radial Length, in(cm)	20.5(52.1)	13.75(33.7)	6.75(17.1)
Wind Load ft²(m²)	0.5(0.05)	0.3(0.03)	0.2(0.02)
Weight, lb(kg)	6(2.7)	5(2.3)	1(.45)

RINGOS

These are the original W1BX FM verticals.

If you want a combination of compact size, wide bandwidth, a low radiation angle, these economical antennas are just for you.

Since radials are not needed, you can even use our Ringos indoors.

Our Ringos are ½ wave and include lightning protection. Put up one of these easily installed antennas and start enjoying FM!

MODEL	**AR-2**	**AR-6**	**AR-10**
Frequency, MHz	135-160	50-54	28-29.7
SWR 1.2:1 Typical 2:1 Bandwidth MHz	10	2	>1.5
Gain, dB	3.75	3.75	3.75
Power Rating, Watts FM	1000	1000	1000
Radiation Angle, Deg.	16	16	16
Horizontal Radiation Pattern, Deg.	360	360	360
Ring Diameter, in (cm)	5(12.7)	13(33)	13(33)
Radiator Base Dia, in (cm)	.75(1.9)	1(2.5)	1(2.5)
Overall Height, ft (m)	3.9(1.2)	10.1(3.1)	17.6(5.36)
Mast Size Range, in (cm)	1.25(3.1)	1.25(3.2)	1.25(3.2)
Wind Load ft² (m²)	.21(.02)	.37(.03)	1.68(.16)
Weight, lb (kg)	1.5(.68)	2.5(1.1)	4(1.8)

MODEL	**AR-220**	**AR-450**
Frequency, MHz	220-225	440-460
SWR 1.2:1 Typical 2.1 Bandwidth, MHz	10	20
Gain dB	3.75	3.75
Power Rating, Watts FM	500	500
Radiation Angle, Deg.	16	16
Horizontal Radiation Pat. Deg.	360°	360°
Ring Diameter in (cm)	5(12.7)	3.5(8.9)
Radiator Base Dia, in (cm)	.75(1.9)	0.5(1.3)
Height, ft(m)	2.6(.78)	1.4(.43)
Mast Size Range, in (cm)	1.25(3.1)	1(2.5)
Wind Load ft²(m²)	.2(.02)	0.1(.01)
Weight, lb(kg)	1.2(.55)	0.3(.14)

RINGO RANGER

This is the antenna that combines good gain with compact size. If space does not allow extra height or decoupling radials, then the ARX-2 is for you!

Gain 4.5 dB, frequency range 135-160 MHz, bandwidth 2:1 SWR greater than 6MHz, length 112″ (2.8m), wind area .33 ft² (.03m²), max mast OD 1.25″ (3.2cm), weight 4 lbs. (1.8kg), power handling 1000 watts.

MOBILES AND RUBBER DUCKS

70 CM, 1-1/4, 2, 6, 10 METERS

NEW

CS28M

An all new magnet mount mobile for 10 meters, is an ideal companion to those new 10 meter multi mode rigs. The antenna is complete with 49" stainless steel whip and spring, 90 pound pull chrome plated magnet with Protective Mylar® pad. Fifteen feet high quality RG-58AU coax and PL-259 connector. You'll be on the air in a matter of minutes, operating mobile to many DX locations.

MOBILES

Our mobiles feature silver-plated coils, stainless steel springs, non-seize hardware, and shock proof coil cases. Plus RG58AU coax and silver-plated connectors for maximum signal transfer from your rig to the antenna.Our VHF models feature 3 dB gain and 5/8 wave electrical length. UHF mobiles provide 5 dB of gain.

Each type is offered with a choice of three mounts. Our popular magnet mounts have 90 pounds of holding power to keep your antenna secure. Our trunk-lip mounts are super easy to install on your trunk lid. And if you want permanent mounting, try our 3/4" hole-mount models.

3 dB Gain VHF
5 dB Gain UHF Mobiles

Model No.	Frequency MHz	Whip Length in	m	Description
CS-147M	144-174	49	1.25	Magnetic
CS-147T	144-174	49	1.25	Trunk Lip
CS-147	144-174	49	1.25	3/4" Hole
CS220M	220-225	33	.84	Magnetic
CS220T	220-225	33	.84	Trunk Lip
CS220	220-225	33	.84	3/4" Hole
CS450M	435-470	29.5	.75	Magnetic
CS450T	435-470	29.5	.75	Trunk Lip
CS450	435-470	29.5	.75	3/4" Hole
CS50M	46-54	49	1.25	Magnetic
CS50T	46-54	49	1.25	Trunk Lip
CS50	46-54	49	1.25	3/4" Hole
CS28M	28-30	49	1.25	Magnetic

RUBBER DUCKS

Our rubber ducks have the long life that you would expect from Cushcraft. Whether you select our mini-duck or standard model, you will get the performance that you want at a price that you can afford!

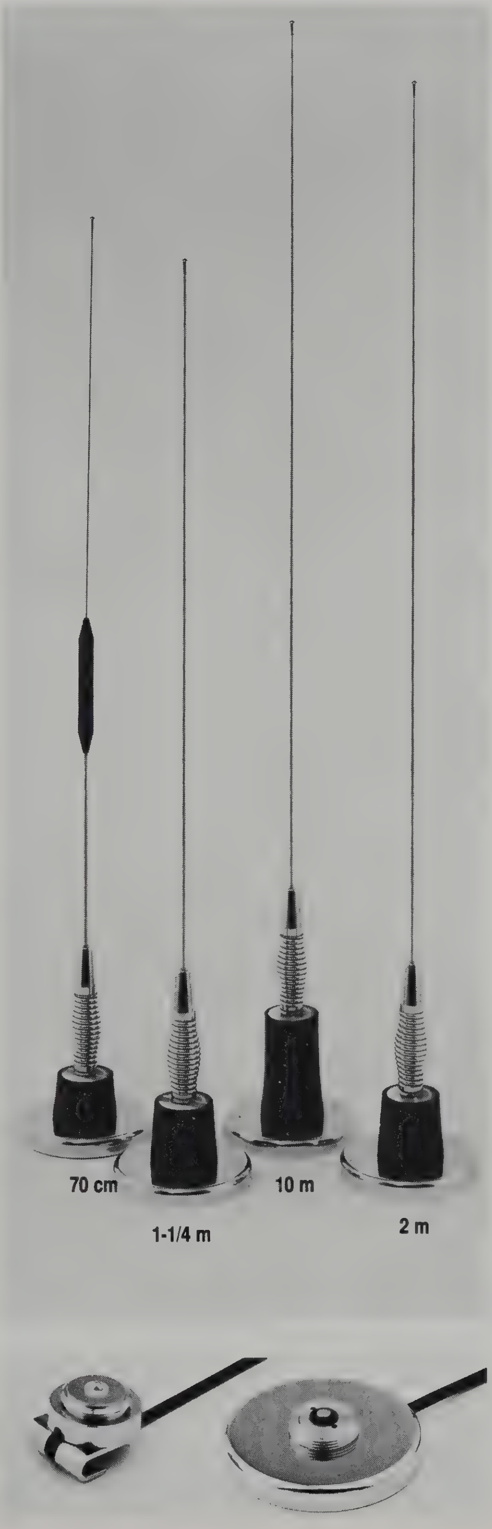
Cushcraft has new long-lasting models with BN connectors for many radios. Ducks with TK connectors are also available for other popular radios.

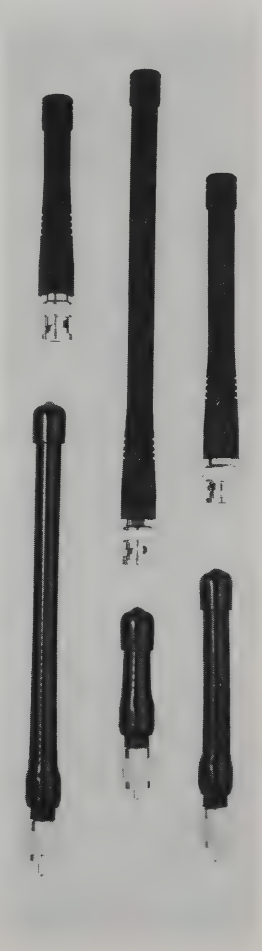
CUSHCRAFT/SIGFLEX SELECTOR CHART

Frequency MHz	Connector Type	6-inch Duck Model	Mini-Duck Model
144-148	BNC	BN141RD	BN141RS
144-148	TK	TK141	TK141S
220-225	BNC	BN220RB	BN220RC
220-225	TK	TK220B	TK220C
430-450	BNC	BN440RB	BN440RC
430-450	TK	TK440B	TK440C

Cushcraft/Signals mobiles and rubber ducks offer the high performance that you need for consistent portable and mobile communications such as commuting and public service activities.

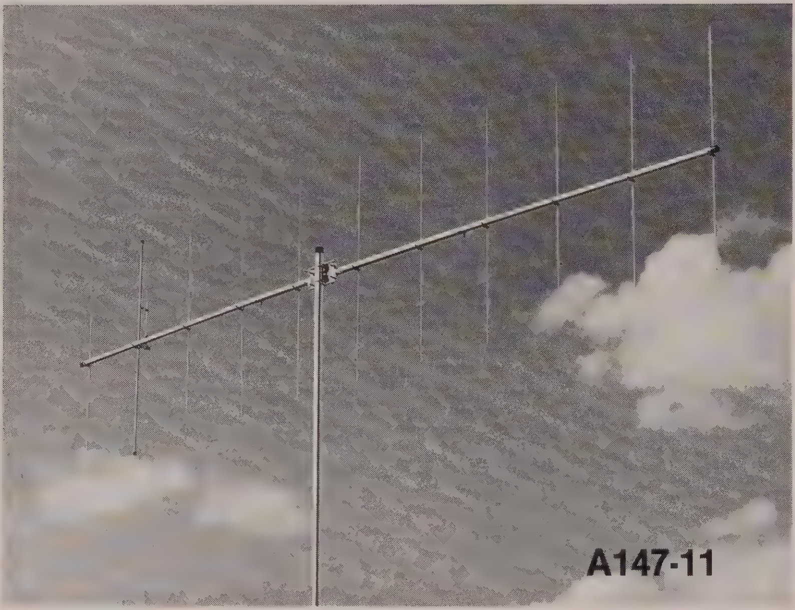
These antennas are the choice not just of hams, but of communications professionals around the world who demand high-quality, premium products.

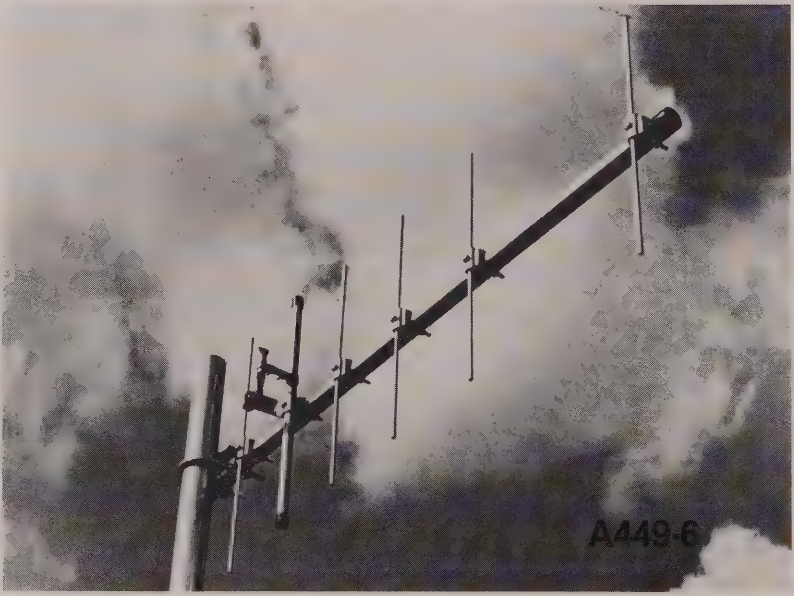


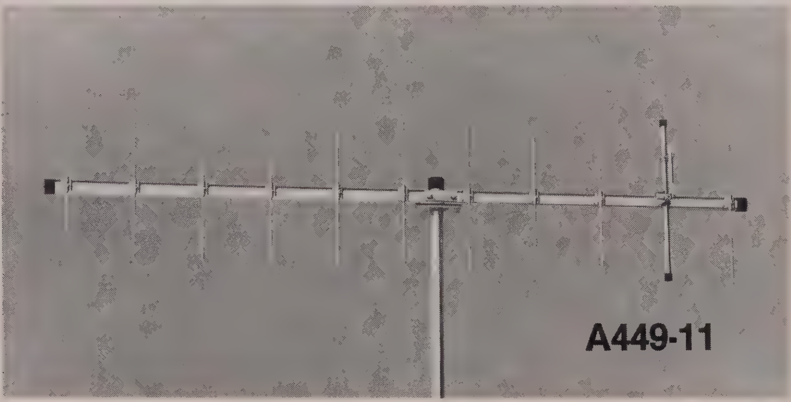


FM YAGIS

70 CM, 1¼, 2 METERS


A147-11


A449-6


A449-11

Try These Popular Antennas

Two antennas have been keys to the growth of FM communication: our eleven element A147-11 and our 22 element A147-22 array. These are favorites because of their reasonable size and high value. Assembly is a snap, too!

These lightweight and durable antennas feature evenly spaced, tapered length solid aluminum rod elements for good bandwidth and include Reddi Match for direct 50 Ohm feed. You will be on the air fast and strong with these antennas!

MODEL	A147-11	A147-22
Frequency	145.5-148	145.5-148
No. Elements	11	22
Forward Gain, dBd	13.2	16.2
Front to Back Ratio, dB	20	20
SWR 1.2:1 Typical 2:1 Bandwidth, MHz	3	3
Power Rating, Watts PEP	800	800
3dB Beamwidth, Degrees E Plane	48	24
Boom Length, ft (m)	12 (3.6)	6.6 x 12(2.1 x 3.6)
Longest Element, in (cm)	40 (101.6)	40 (101.6)
Turning Radius, ft (m)	6 (1.8)	6.6 (2.0)
Mast Size Range, in (cm)	1.25-1.5 (3.2-3.8)	1.25-1.5 (3.2-3.8)
Wind Load, ft^2 (m^2)	1.21 (0.11)	2.82 (.26)
Weight, lb (kg)	6 (2.7)	15 (6.8)

MODEL	A449-6	A449-11
Frequency	440-450	440-450
No. Elements	6	11
Forward Gain, dBd	10.5	13.2
Front to Back Ratio, dB	18	20
SWR 1.2:1 Typical 2:1 Bandwidth, MHz	>10	>10
Power Rating, Watts PEP	350	350
3dB Beamwidth, Degrees E Plane	60	48
Boom Length, ft (m)	2.9 (0.89)	4.2 (1.35)
Longest Element in (cm)	13 (33)	13 (33)
Turning Radius, ft (m)	2.9 (.89)	2.8 (.85)
Mast Size Range, in (cm)	1.25-2.0 (3.2-5.1))	1.5-1.75 (3.8-4.4))
Wind Load, ft^2 (m^2)	0.30 (0.03)	0.39 (0.04)
Weight, lb (kg)	3 (1.4)	4 (1.8)

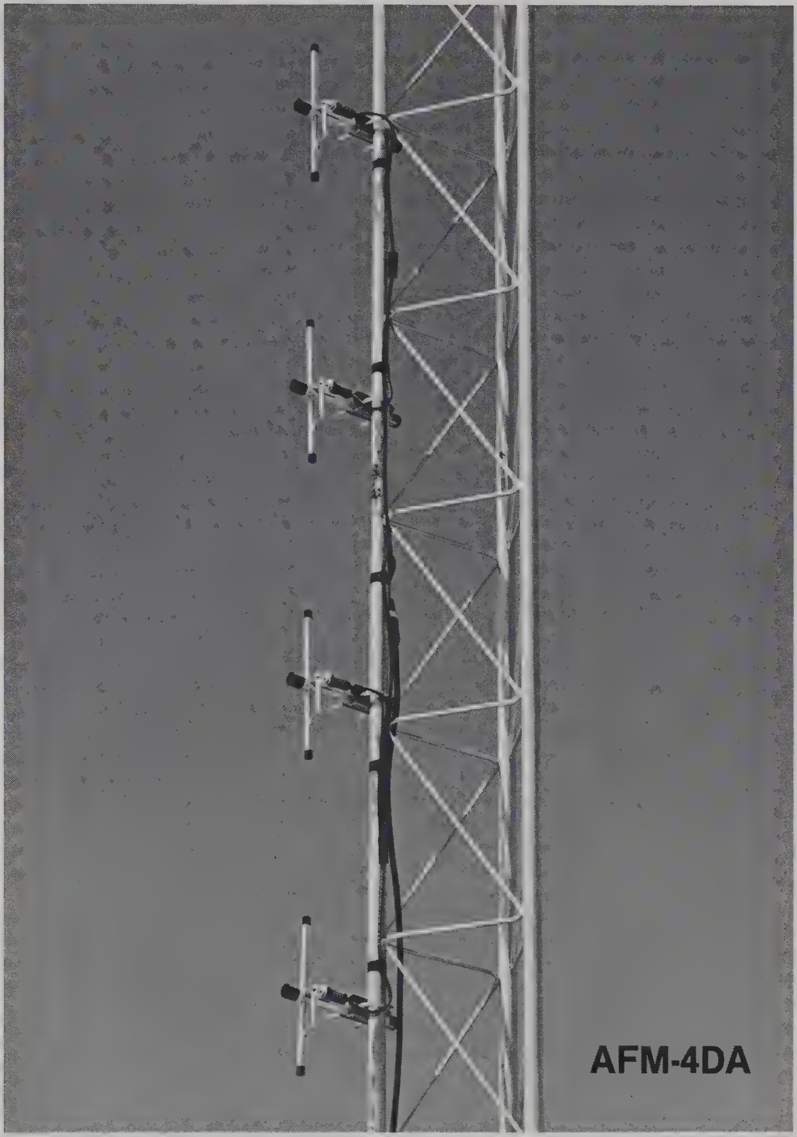
STACKING KITS

Our VPK stacking kits for the antennas above are supplied complete with mounting boom, harness, and hardware.

Antenna	Frequency MHz	Complete Kit	Harness Only
A147-4	144.5-148	A14-VPK	A14-SK
A147-11	144.5-148	A147-VPK	A147-SK
A220-7	220-225		A21-SK
A449-6	440-450		A449-SK
A449-11	440-450	A449-VPK	A449-SK

MORE FM ANTENNAS

70 CM, 1¼, 2 METERS



FOUR POLE ARRAYS

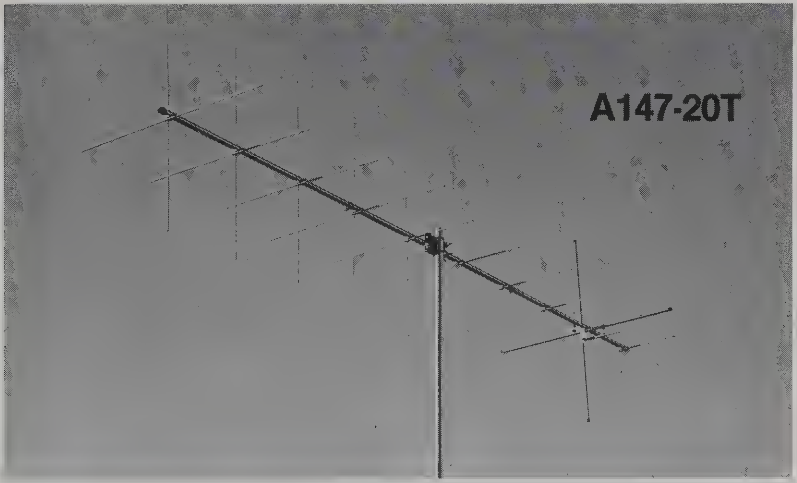
Cushcraft's four 1/2 wave dipole array is perfect for your repeater or as a powerful base antenna.

Strong through-the-boom dipole mounting ensures long life and superior electrical characteristics.

The dipoles mount to your tower's legs or on a separate support mast (not included). They can be arranged for omni or elliptical patterns.

MODEL	AFM-4DA	AFM-24DA
Frequency	144-148	220-225
Gain, dBd	9 Offset, 6 Omni	9 Offset, 6 Omni
SWR 1.2:1 Typical 2:1 Bandwidth	>10	>15
Power Rating, Watts FM	1000	1000
Radiation Angle Degrees	6	6
Horizontal Radiation Pattern Deg.	360-Variable	360-Variable
Height, ft (m)	23 (7.0)	15 (4.5)
Mast Size Range, in (cm)	1.5-2.0 (3.8-5.1)	1.5-2.0 (3.8-5.1)
Wind Load, ft² (m²)	2.54 (.24)	1.85 (.17)
Weight, lb (kg)	7 (3.2)	6 (2.7)

MODEL	AFM-44DA
Frequency	435-450
Gain, dBd	9 Offset, 6 Omni
SWR 1.2:1 Typical 2:1 Bandwidth	>20
Power Rating, Watts FM	1000
Radiation Angle Degrees	6
Horizontal Radiation Pattern Deg.	Variable, to 360
Height, ft (m)	8 (2.4)
Mast Size Range, in (cm)	1.25-2.0 (3.2-5.1)
Wind Load, ft² (m²)	1.13 (.11)
Weight, lb (kg)	5 (2.3)



2 METER HI-LO CROSS YAGI

Here's the antenna that solves multi-mode problems! Ten vertically polarized and ten horizontally polarized elements provide 11.1 dBd gain in the 144.5-148 segment of the two meter band. The horizontal elements handle your CW and SSB needs, while the vertical elements cover FM.

The A147-20T has a boom length of 130 in. (3.3m), longest element length of 40 in. (1.0 m), wind area of 1.42 ft² (.13m²), and a mast size of 1.25-1.5 in. (3.2-3.8 cm)

SIDEBAND YAGIS

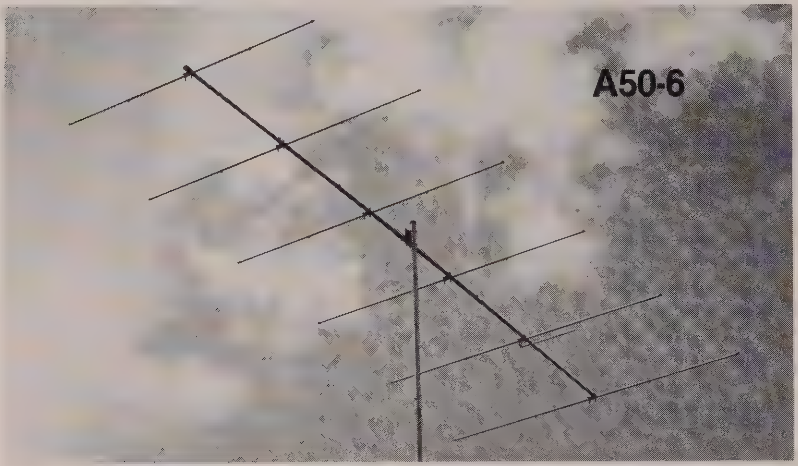
70 CM, 2, 6, 10 METERS

The performance of these budget-priced antennas will surprise you! They are lightweight, durable, and will have you on the air in a single afternoon!

Good bandwidth, tapered length elements, Reddi Match for direct 50 Ohm feed, and a moisture sealing vinyl connector boot are some major features of these fine antennas.

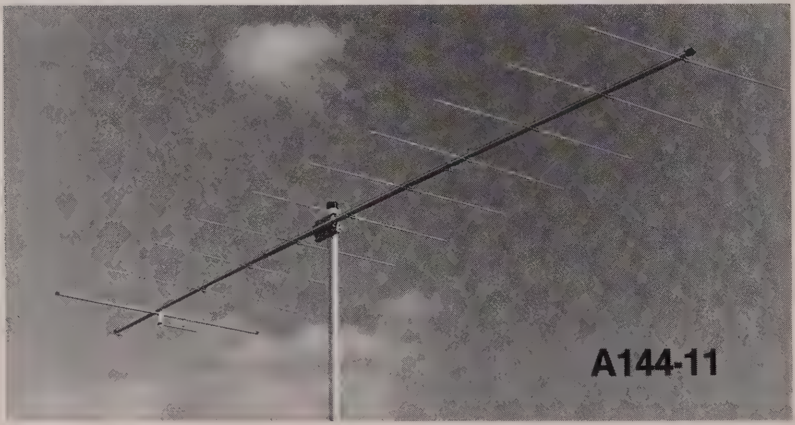
NEW TEN-3

Our all new 3 element beam for the novice technician or any ham who wants more gain with a good front to back ratio on 10 meters. This antenna has an 8 foot boom making it easy to install on a very simple mount with only a light weight rotator. The matching system is our proven Reddi Match for 50 Ohm no balun feed and SO-239 connector. Make more positive contacts with the new TEN-3.



MODEL	A50-3	A50-5	A50-6
Frequency	50-54	50-54	50-54
No. Elements	3	5	6
Forward Gain, dBd	8	10.5	11.2
Front to Back Ratio, dB	20	22	24
SWR 1.2:1 Typical			
2:1 Bandwidth, MHz	>1	>1	>1
Power Rating, Watts PEP	1000	1000	1000
3dB Beamwidth, Degrees			
E Plane	76	56	48
Boom Length, ft (m)	6 (1.8)	12 (3.7)	20 (6.1)
Longest Element, in (cm)	117 (300)	117 (300)	117 (300)
Turning Radius, ft (m)	6 (1.8)	7.5 (2.3)	11 (3.4)
Mast Size Range, in (cm)	1.5 (3.8)	1.5 (3.8)	1.5-2(3.8-5.1)
Wind Load, ft² (m²)	1.80 (0.17)	2.74 (0.25)	4.46 (.41)
Weight, lb (kg)	7 (3.2)	11 (5.0)	18 (8.2)

MODEL	TEN-3	A144-11
Frequency	28-29.7	144-146
No. Elements	3	11
Forward Gain, dBd	8	13.2
Front to Back Ratio, dB	25	20
SWR 1.2:1 Typical		
2:1 Bandwidth, MHz	>1.5:1	>3
Power Rating, Watts PEP	2000	1000
3dB Beamwidth, Degrees		
E Plane	64	38
Boom Length, ft (m)	8 (2.44)	12 (3.7)
Longest Element, ft (m)	18 (5.49)	3.3 (1.0)
Turning Radius, ft (m)	9.8 (3.0)	6.75 (2.0)
Mast Size Range, in (cm)	1.5-2(3.8-5.1)	1.25-1.5(3.1-3.8)
Wind Load, ft² (m²)	2.0 (.20)	1.21(.11)
Weight, lb (kg)	9.9 (4.45 kg)	6 (2.7)



MODEL	A144-7	A430-11
Frequency	144-146	430-435
No. Elements	7	11
Forward Gain, dBd	11.1	13.2
Front to Back Ratio, dB	20	20
SWR 1.2:1 Typical		
2:1 Bandwidth, MHz	>3	>10
Power Rating, Watts PEP	1000	350
3dB Beamwidth, Degrees		
E Plane	46	38
Boom Length, ft (m)	8.2 (2.5)	4.7 (1.4)
Longest Element, in (cm)	40.25 (100)	14 (35)
Turning Radius, ft (m)	4.9 (1.5)	2.6 (.81)
Mast Size Range, in (cm)	1.5-2(3.8-5.1)	1.25-1.5(3.1-3.8)
Wind Load, ft² (m²)	0.81 (0.08)	0.42 (0.04)
Weight, lb (kg)	4 (1.8)	3 (1.4)

SPECIALIZED ANTENNAS

70 CM, 2 METERS

DX ARRAYS FOR AMATEUR TELEVISION

Take a look at our DX-420 arrays. If you are active in ATV you will appreciate the broadband performance that makes amateur television reception and transmission clear. These arrays are perfect for EME, too. Phase collinear elements give excellent gain and broadband performance for your favorite activity.

MODEL	**DX120**	**DX420**
Frequency, MHz	144-148	420-440
No. Elements	20	20
Forward Gain, dBd	14	14
Front to Back Ratio, dB	18	18
SWR 1.2:1 Typical		
2:1 Bandwidth, MHz	>4	>20
Power Rating, Watts PEP	2000	1500
3dB Beamwidth Degrees		
E Plane	45	45
Boom Length, ft(m)	6.25 x 2.5 (191 x 76)	2.4 x .9 (73.7 x 28)
Longest Element, in.(cm)	81 (205.7)	28(71.1)
Turning Radius, ft(m)	4(1.2)	1.5(.46)
Mast Size Range in(cm)	1.25-1.5(3.1-3.8)	1.25-1.5 (3.1-3.8)
Wind Load, ft²(m²)	1.53(.14)	.64(.06)
Weight, lb(kg)	8(3.6)	6(2.7)

OSCAR
The Complete Antenna System

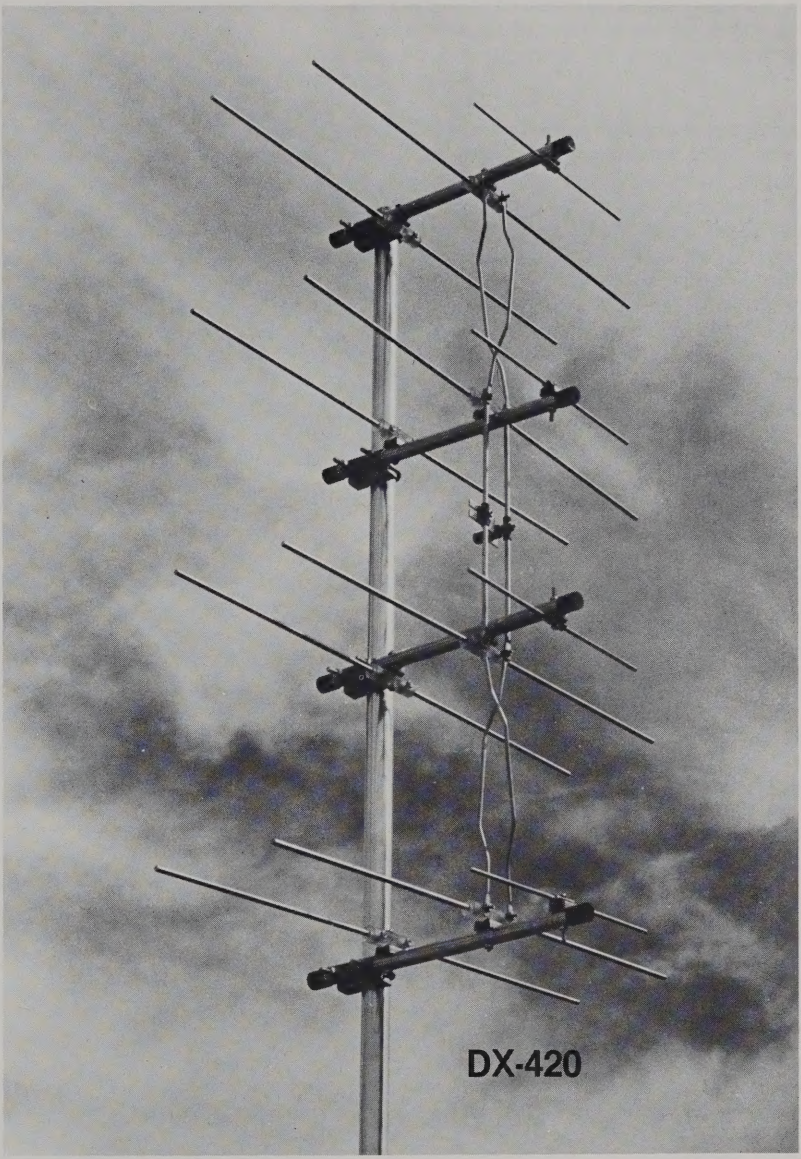
Here's the system that will get you up and running in a hurry. Cushcraft's AOP-1 includes our 416TB uplink, A144-20T downlink, A14-TMB mounting boom, and all of the hardware for quick assembly and installation.

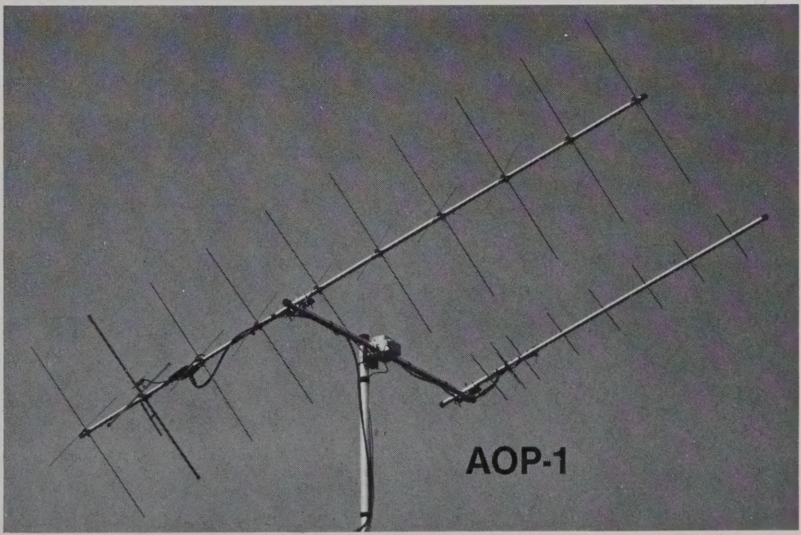
True selectable left or right circular polarization (see our optional PS4 switcher below), and fine performance make the AOP-1 the right choice for your OSCAR contacts.

You can use our A14T-MB mounting kit for easy installation and compatibility with the U110 elevation rotor. Order as a complete system or buy individual components.

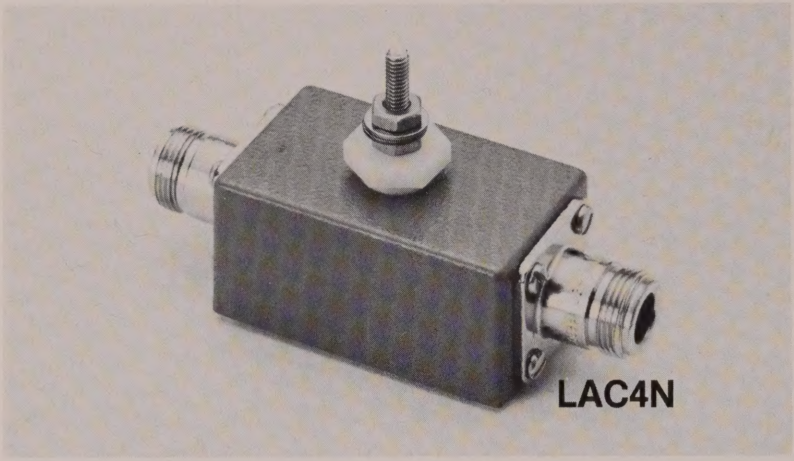
OSCAR operation will be more fun with the remote polarity switch mounted right on the 416TB. You will access satellites having either left or right polarization.

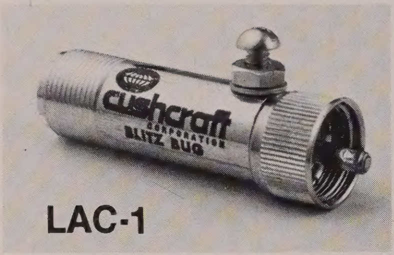
MODEL	**A144-10T**	**A144-20T**	**416TB**
Center Frequency (MHz)	145.9	145.9	435
No. Elements	2 x 5	2 x 10	2 x 8
Forward Gain, dBd	10.5	12.2	12.5
Front to Back Ratio, dB	20	20	20
SWR 1.2:1 Typical			
2:1 Bandwidth MHz	>2	>2	20
Power Rating, Watts PEP	800	800	1500
3dB Beamwidth Degrees			
E Plane	52	38	34
Boom Length, ft(m)	5.83(1.8)	10.83(3.3)	6.7(2.03)
Longest Element, in.(cm)	40(101.6)	40(101.6)	13.3(33.8)
Turning Radius, ft(m)	3.4(1.04)	5.8(1.78)	6.7(2.04)
Mast Size Range in(cm)	1.25-1.5 (3.2-3.8)	1.25-1.5 (3.2-3.8)	1.5-2.0 (3.8-5.1)
Wind Load, ft²(m²)	.74(.07)	1.42(.13)	0.5(.05)
Weight, lb(kg)	3.5(1.6)	6.6(3.0)	4.9(2.2)

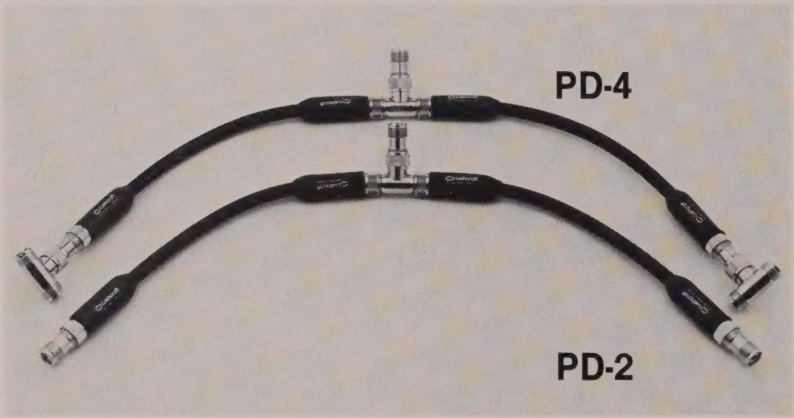

DX-420


AOP-1

ANTENNA ACCESSORIES







FAST ACTING GAS DISCHARGE LIGHTNING ARRESTERS

Protect your valuable equipment from surges of up to 5,000 amperes with a Cushcraft constant impedance LAC4 arrester! The LAC4 has a replaceable gas discharge tube which clamps voltage surges to less than 50 volts in about 100 nanoseconds—much quicker than the voltage rise time of lightning.

You cannot afford to be without lightning protection. One of the models below is right for your shack.

LAC4	200 watt with UHF SO-239 connectors
LAC4H	2kw with UHF SO-239 connectors
LAC4N	200 watt with N connectors
LAC4NH	2kw with N connectors
LC2	200 watt replacement cartridge
LC2KW	2kw replacement cartridge

BLITZ BUG LIGHTNING ARRESTERS

Cushcraft also recommends this well-known series of arresters which are based on a patented three point static discharge design. The Blitz Bug has a sealed air chamber, constant static drain, and controlled voltage discharge.

The Blitz Bug is rated at 2kw PEP to 500MHz with negligible insertion loss.

LAC-1	with UHF PL-259 and SO-239 connectors
LAC-2	with UHF SO-239 connectors

POWER DIVIDERS FOR BOOMERS

Our power dividers make it a snap to stack Cushcraft Boomers. They are available for these antennas:

PD-2	for two 32-19, 215WB, or 4218XL's
PD-4	for four 32-19, 215WB, or 4218XL's
PD-222	for two 220B, 224WB, or 225WB's
PD-224	for four 220B, 224WB, or 225WB's

STACKING FRAMES AND HARNESSES FOR BOOMERS

For even easier installation of our Boomers, use our installation kits that are complete with harness and power divider.

617-SK	for two 617-6B's
22-SK	for two 215WB's
32-SK	for two 32-19's

BOOMER STACKING INFORMATION

Antenna	2X617-6B	2X215WB	4X215WB	2X32-19	4X32-19	2X220B	4X220B	2X424B	4X424B	2X4218XL	4X4218XL
Forward Gain, dBd	16.6	18.5	21.5	18.8	21.2	19.8	22.4	20.8	23.4	20.2	23.2
Front/Back Ratio, dB	30	24	24	24	24	30	30	30	30	24	24
E-Plane Beamwidth, deg	2X17.5	2X17	2X8.5	2X14	2X7.5	2X13	2X6.5	2X9.5	2X4.8	2X13	2X6.5
H-Plane Beamwidth, deg	2X10	2X9	2X9	2X8.5	2X7	2X7	2X5.5	2X5.5		2X7.25	2X7.25
Stacking Distance											
Vert, ft	26	10	10	12	12	8	8	5.0	5.0	12.63	12.63
(m)	7.92	3.05	3.05	3.66	3.66	2.44	2.44	1.97	1.97	3.85	3.85
Horiz, ft	—	—	10	—	13	—	8.5	—	5.5		13.38
(m)	—	—	3.05	—	3.96	—	2.59	—	2.16		4.08
Approximate Weight,											
lb	62	22	44	26	97	23	76	16	55	32.5	115
(kg)	28.12	10.00	20.00	11.79	44.00	10.40	34.40	7.26	24.95	14.8	52.3

ANTENNA FACTS AND TERMINOLOGY

This compendium is intended to explain and simplify many of the antenna terms that you will find in this catalog. It will be helpful to the newer less experienced radio amateur, or those who have been away from the hobby for a time, in selecting the proper antenna for his or her installation. It will also assist with "on the air" discussions about antennas. There are many books available, through your dealer, which describe antenna design theory and installation with great detail.

GAIN is a measure of the power amplification factor of the antenna. In proper Yagi beam designs, gain is primarily a function of boom length. At VHF and UHF frequencies very high gain can be achieved because booms can be physically long with more elements. This has the effect of increasing the transmitting and receiving power of the antenna.

dB is an abbreviation for decibel. It is a mathematical expression that shows the relationship between two values. An increase in gain of 3dB is a doubling of power. Gain figures have to be related to a reference antenna. For horizontally polarized antennas the symbol dBd indicates that a half wave dipole was used as the reference. For vertical antennas, a 1/4 wavelength vertical over a perfect ground is the standard. When the term dB is used without a reference then it is assumed that the reference is a theoretical point source called and isotropic radiator, referred to as dBi.

FRONT TO BACK RATIO is a measure of the signal (power) radiated or received from the front of the antenna to signals from the back of the antenna.

RADIATION PATTERN is the result of the designer's skill in achieving good forward gain and front to back ratio. At Cushcraft, we use these skills with computer aided design to combine the right boom and element lengths with proper spacing between the elements to achieve clean radiation patterns. Think of the radiation pattern as similar to a flashlight beam. A narrow beam focuses for greater distance, while a wide beam will not reach as far. Long boom antennas will have narrower patterns which may be focused more accurately to receive and transmit distant signals. The radiation patterns shown in the catalog illustrate this for many antennas.

VSWR is voltage standing wave ratio. You will find it listed as SWR in the specification charts. When properly installed the antennas in this catalog should show an SWR of 1.2:1, or less at the center of their operating frequency range. The 2:1 SWR bandwidth is the range over which the antenna will operate without exceeding 2:1 SWR, allowing your transceiver to operate at its full power output. Most models may be tuned or optimized for your favorite operating range CW, phone or in many cases center band.

IMPEDANCE fifty Ohms is the value RF engineers have agreed to design for in applications requiring RF connection between equipment. In most radio communications, antenna feed point impedances between 25 and 100 Ohms are acceptable. Cushcraft engineers use various techniques, depending on the application to achieve the best impedance match of 50 Ohms between the antenna and connecting cable from your radio.

BANDWIDTH is the frequency range over which the antenna provides optimum performance. Specific SWR bandwidths are shown for each model. The antennas in this catalog are designed so that the best gain and SWR are achieved over the same bandwidth.

POLARIZATION refers to the plane of the antenna elements in relation to the earth, either horizontal or vertical. Cross polarization such as trying to contact a vertically polarized mobile station antenna with a horizontally polarized beam will reduce the efficiency of the link and shorten the range of communications. This theory also applies to fixed or base station antennas. Most antennas used for FM communications are mounted with their elements in the vertical plane. For OSCAR satellite communications, antennas are specially designed to give circular polarization to compensate for satellite rotation. At HF frequencies below 30 MHz polarization is less of a factor because radio signals are subject to change as they reflect from the ionosphere back to earth.

RADIATION ANGLE is used to describe the angle which the signal radiates to or from the antenna in relation to the earth's horizon. It is applied primarily to vertical antennas. Angles of radiation as close to the horizon as possible are preferred for good communications. At HF frequencies this is accomplished by using half wave antennas, like the R5. At VHF and UHF frequencies multiple vertical elements, one above the other, are used to lower the radiation angle and provide gain over a quarter wave vertical.

ELEMENTS. All antennas have elements. The basic element is a half wave dipole, see page 2. Yagi beam antennas use more than one element to achieve a desired gain and pattern. Vertical antennas are also a configuration of the half wave dipole. Many verticals are one quarter wavelength long which require some type of ground radial system for proper impedance matching. Designs like the Ringo Rangers and UHF mobile antennas use multiple half wave elements for greater range.

BEAMS can be described as high performance antennas. They have a center support boom and multiple elements. Beams incorporate many of the techniques described above to improve both the transmission and reception of ham radio signals. Beams are often called Yagi's after their inventors, H. Yagi and S. Uda. At VHF and UHF frequencies beams are usually designed to give maximum performance on one band. They are usually called monoband beams. Space and size may be a problem at HF frequencies so engineers have developed multi-band trapped beams. Antennas like the A3 and A4S operate on 10, 15 and 20 meters. With the addition of specially designed add-on kits they will also operate on 40 meters. The tri-band beam requires less space and a smaller support structure than separate monoband beams.

HF VERTICALS are usually designed to cover many ham bands. They radiate and receive in all directions eliminating the need for rotators. Verticals are relatively small size, making them a convenient and cost effective way to operate your station. HF verticals are most often ground or roof mounted. Most verticals need extensive ground radial systems. While they are excellent starter or novice antennas, HF verticals are also used successfully by many experienced ham operators.

TRAPS are L/C circuits used in multiband vertical or beam antennas to divide the antenna into sections for operation on separate bands. Multiband trapped antennas electronically select the proper antenna sections as you change band on your transceiver.

STACKING of antennas is used to increase performance. Two or more antennas may be mounted on a support mast or tower at designed distances. Special coaxial cables, sometimes called harnesses, and power dividers are used. They provide the correct impedance matching and allow the use of a single 50 Ohm coaxial cable from the transceiver. Stacking is used to increase forward gain by compressing the pattern. Theoretically two stacked antennas have twice the radiated power output (a 3 dB increase) of a single antenna. To increase the gain another 3 dB two more antennas must be added making a total of four and sometimes called an array. Cushcraft offers many stacking kits, described throughout this catalog.

LOCATION is very important. Put your antenna where it will be safe. Antennas are electrical conductors. When they are used with transceivers and amplifiers high voltages can be developed on many parts of the antenna. Pick a spot where people and pets will not come in contact with your antenna when it is operating. Ground mounted verticals and their radials should be guarded. Place your antennas in locations where there is no chance of coming in contact with power lines during installation or removal.

WIND SURVIVAL is a measure of how well the antenna will survive in a wind storm. Cushcraft antennas are designed to survive steady 80 mph winds with a safety margin. Actual survival will depend upon the quality of your installation. Wind surface area shown in each specification chart will help you to determine if the tower or support structure which you have selected is adequate to handle your antennas.

LIGHTNING PROTECTION. The build up of static electricity and lightning charges can be very harmful to amateur radio equipment. The degree of exposure to this kind of damage can be reduced by several methods. One is the addition of a lightning arrester in the coaxial feed cable. These arresters may be placed just outside the building at the point where the cable enters the building. Cushcraft offers two types, the gas discharge which is very fast acting offers the most protection. The air gap type reduces static and is more economical.

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A LEADER FOR OVER 30 YEARS

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